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SPECTRUM SIGNATURE MEASUREMENTS ON AIR ROUTE SURVEILLANCE RADAR (ARSR-1B-A) AT POINT ARGUELLO, CALIFORNIA

TECHNICAL DOCUMENTARY REPORT NO. RADC-TDR-63-363
Prepared Under
Contract Number AF 30(602)-2537, Order Number 11
March 1963

Prepared for
ELECTROMAGNETIC VULNERABILITY LABORATORY
ROME AIR DEVELOPMENT CENTER
RESEARCH and TECHNOLOGY DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
GRIFFISS AIR FORCE BASE, NEW YORK

JANSKY & BAILEY
A Division of Atlantic Research Corporation
Washington, D. C. Alexandria, Va.

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FOREWORD

The work reported herein was carried out by the following members of the staff of Jansky and Bailey, A Division of Atlantic Research Corporation, Washington, D.C. and Alexandria, Virginia; and the Frederick Research Corporation, Wheaton, Maryland:

James J. Crenca	Project Director	J & B
Carl P. McCall	Project Engineer	J & B
James T. Luck	Associate Engineer	J & B
Barbara M. Davidson	Editorial Consultant	J & B
James D. Powers	FRC Team Leader	F R C
Harry Zinc	Engineer	F R C
John R. Wibbe	Engineer	F R C
M. Marks	Technician	F R C

The spectrum signature measurement team received very valuable assistance and advice from Richard E. Filarsky and Wesley D. Becker of the Plans and Programs Department, U.S. Naval Missile Facility, Point Arguello, California. Assistance was also given the measurement team by the following personnel from the Federal Electric Corporation.

R. W. Scheurer
T. Bovee
J. R. Duffey
C. Ingram
A. Herman
R. C. Gardner

The entire program was coordinated through 1st Lt. Virgil D. Kempton, Task Engineer, RAUMM-3, RADC.

Suggested Keywords: Spectrum characteristics, Electromagnetic equipment

ABSTRACT

This report describes the spectrum signature measurements made on an Air Route Surveillance Radar (ARSR-1B-A) located at the U.S. Naval Missile Facility, Point Arguello, California.

Description of the tests and results of the measurements are given for the ARSR-1B-A transmitter and were made in accordance with the specifications and procedures of MIL-STD-449A. Data reported herein will be used as an input to the DOD Electromagnetic Compatibility Analysis Center library of spectrum signatures.

Approved by:

James J. Crenca
Project Director

Prepared by:

Carl P. McCall
Project Engineer

PUBLICATION REVIEW

This report has been reviewed and is approved. For further technical information on this project, contact Lt. Travis MacClendon, Jr., RAUMM-3, Ext. 23282.

Approved: Travis MacClendon
TRAVIS MACCLENDON
2nd Lt., USAF
Project Engineer

Approved: Samuel D. Zaccari
SAMUEL D. ZACCARI, Chief
Electromagnetic Vulnerability Lab
Directorate of Communications

FOR THE COMMANDER:
IRVING J. GABELMAN
Director of Advanced Studies

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INTRODUCTION

1.1 GENERAL

Spectrum characteristics for both existing transmitters and receivers and for developmental and planned equipments are needed to predict the mutual interference effects of electromagnetic equipment. The data obtained from the collection of spectrum signatures will comprise one of the principal aids in predicting the performance in and effect on the electromagnetic environment of other equipments and systems by a particular equipment or system. A spectrum signature is defined as the package of data which describes the electromagnetic radiating and receiving characteristics of an equipment. In order to collect spectrum signatures that are both meaningful and valid, a technical standard (MIL-STD-449A) has been adopted which establishes uniform measurement techniques that are applicable to the determination of the spectral characteristics of radiofrequency transmitters and receivers. Measurements made under this task were made according to the specifications and procedures outlined in MIL-STD-449A and Order No. 11. These measurements will be used as an input to the DOD Electromagnetic Compatibility Analysis Center library of spectrum signatures. The numbered MIL-STD-449A tests to be made on pulsed radar equipment are listed below.

TRANSMITTER

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RECEIVER

5.3.4 Sensitivity
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5.4.2 Antenna Patterns

Tests added and deleted from this schedule are discussed in Section 1.3.

This report describes the measurement details and presents the spectrum signature of the Air Route Surveillance Radar (ARSR-1B-A) located at the Naval Missile Facility in Point Arguello, California.

1.2 EQUIPMENT MEASURED

Air Route Surveillance Radar (ARSR-1B-A) is a pulse type dual radar system designed to be incorporated into the civil airways system as an aid to air navigation. This radar normally operates in a frequency range of 1280 - 1350 Mc. The radar, however, may be operated at frequencies as low as 1240 Mc. Each equipment consists of dual transmitting, receiving, and moving target indication channels to permit constant surveillance of aircraft to a greater than 200-mile radius of the radar site. A four-part waveguide switch and an RF dummy load enables radiation of one channel directly into the antenna while the remaining channel can be completely energized and radiated into the dummy load for maintenance purposes. The amplitron output of the transmitter delivers a nominal 2 microsecond pulse at a 360 cycle repetition rate with a peak power of approximately 99 dbm to the antenna.

The antenna assembly is a large high gain antenna with nominal beam width dimensions of 1.35 degrees horizontal by 6.2 degrees vertical. The array dimension of this antenna is 40 by 11 feet compound curved which results in a nominal antenna gain of 34.3 db along the axis of maximum radiation. Antenna polarization may be horizontal, linear, or circular, remotely selectable over the band with no tuning adjustments required. Azimuth rotational speeds of 6, 9, and 12 rpm are available.

1.3 EQUIPMENT CHARACTERISTICS MEASURED

Spectrum signature measurements on the ARSR-1B-A radar at Point Arguello were limited to the period of time between December 2, 1962, and December 21, 1962. As a consequence, all receiver tests as specified by MIL-STD-449A were exempted by Order No. 11. A priority schedule was established for the remaining spectrum signature tests. The order of priority is listed below.

1. Transmitter measurements through second harmonic.
2. Antenna Patterns through the second harmonic taken with an azimuth rotational speed of not greater than 1 rpm. Antenna Patterns to be taken at only one test site.
3. Pulse Count Test (not specified by MIL-STD-449A).
4. Transmitter measurements above second harmonic to be continued to completion or to December 21, 1962.

Antenna Patterns were not obtained due to the high wind velocities and limited time permitted for restoring the antenna to normal operation. This is explained in more detail in Section 5.4.2.

1.4 MEASUREMENT FREQUENCIES

The nominal frequency range of the ARSR-1B-A is 1280 - 1350 Mc. At the time these measurements were started, however, Naval regulations limited the operating frequencies to the range below 1310 Mc. In view of this, the normal operating frequency of this radar (1297.8 Mc) was selected as the mean standard test frequency. At a later date, authorization was secured to operate at one frequency (1348 Mc) above the 1310 Mc limit. This frequency was used as the higher standard test frequency. Although the nominal frequency range of the radar is 1280 - 1350 Mc, the radar's lower frequency limit is 1240 Mc. Since a spectrum signature should be representative of the radar's full capability, a lower standard test frequency of 1257.8 Mc was selected. To recap, the three standard test frequencies are listed below.

$$f_{oe} = 1257.8 \text{ Mc}$$
$$f_{om} = 1297.8 \text{ Mc}$$
$$f_{oh} = 1348 \text{ Mc}$$

The actual frequencies used from day to day may differ from the above by as much as 1 Mc due to the difficulty in tuning the radar's magnetron. The radar was "talked" on frequency by measuring the radar frequency at the far-field test site.

Section 2

DESCRIPTION OF SITES AND SITE ENVIRONMENT

The Air Route Surveillance Radar (ARSR-1B-A) is located on the Remote Radar site in the Naval Missile Facility at Point Arguello, Lompoc, California. This site is on the southern boundary of the Missile Range as shown in Figure 2-1. Coordinates of the site are 120° 35' 18" W and 34° 35' 48" N. Figure 2-2 is an aerial view looking southwest of Lompoc, California, and the Naval Missile Facility. Lompoc is in the valley in the foreground with the Missile Facility in the mountainous terrain in the background. The Pacific Ocean is seen in the upper part of the photograph. Tranquillon Peak is the high point just to the left of center near the Pacific Ocean. Figures 2-3 and 2-4 are aerial views of the Remote Radar site looking north. In the photograph from left to right are the APS-20, ARSR Antenna, operations building, microwave tower and FPS-6. Most of the site is at a ground elevation of 1545 feet except for the portion on which the FPS-6 is located. This ground is at an elevation of 1533 feet. The total elevation of the various components of the Remote Radar Site is as follows:

APS-20, 1560 ft; ARSR Antenna, 1582 ft; microwave tower, 1685 ft; FPS-6, 1598 ft.

Only one test site was used in this spectrum signature collection. This test site was at the FIC (Frequency Interference Control) installation. The test site was at a distance of 21,560 feet and on a bearing of 65° 20' from the Remote Radar site. Figure 2-5 is a photograph taken from the Remote Radar site looking toward the Test Site at FIC. Figure 2-6 is a photograph taken from the Test Site at FIC looking toward the Remote Radar Site. Figure 2-7 is a photograph of the measurement van on the FIC (Test Site) installation. The test antenna (horn) is shown mounted atop a pole which is mounted to the measurement van. Power for the van test equipment was obtained from the FIC installation.

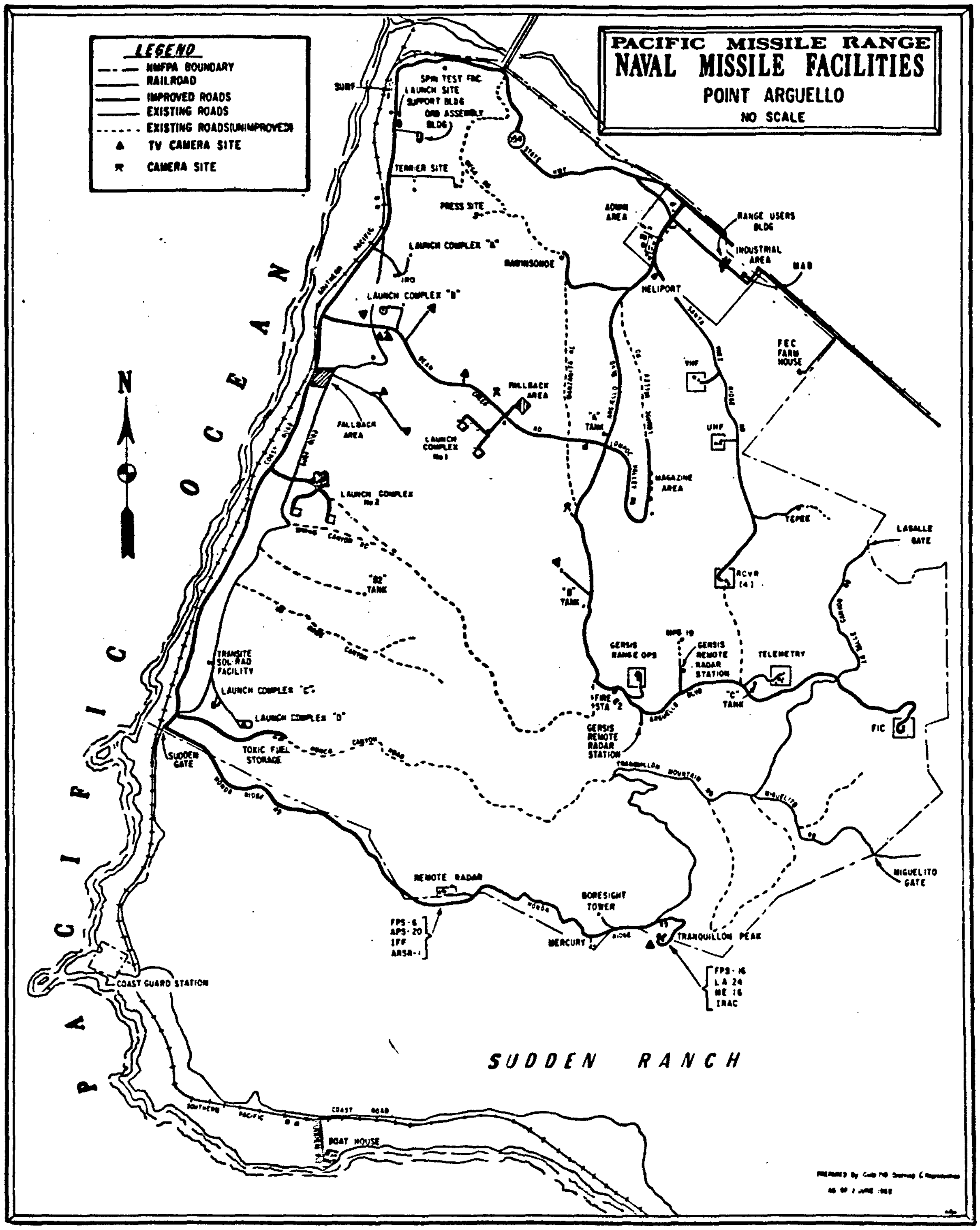


Figure 2-1. U.S. Naval Missile Facility-Point Arguello.

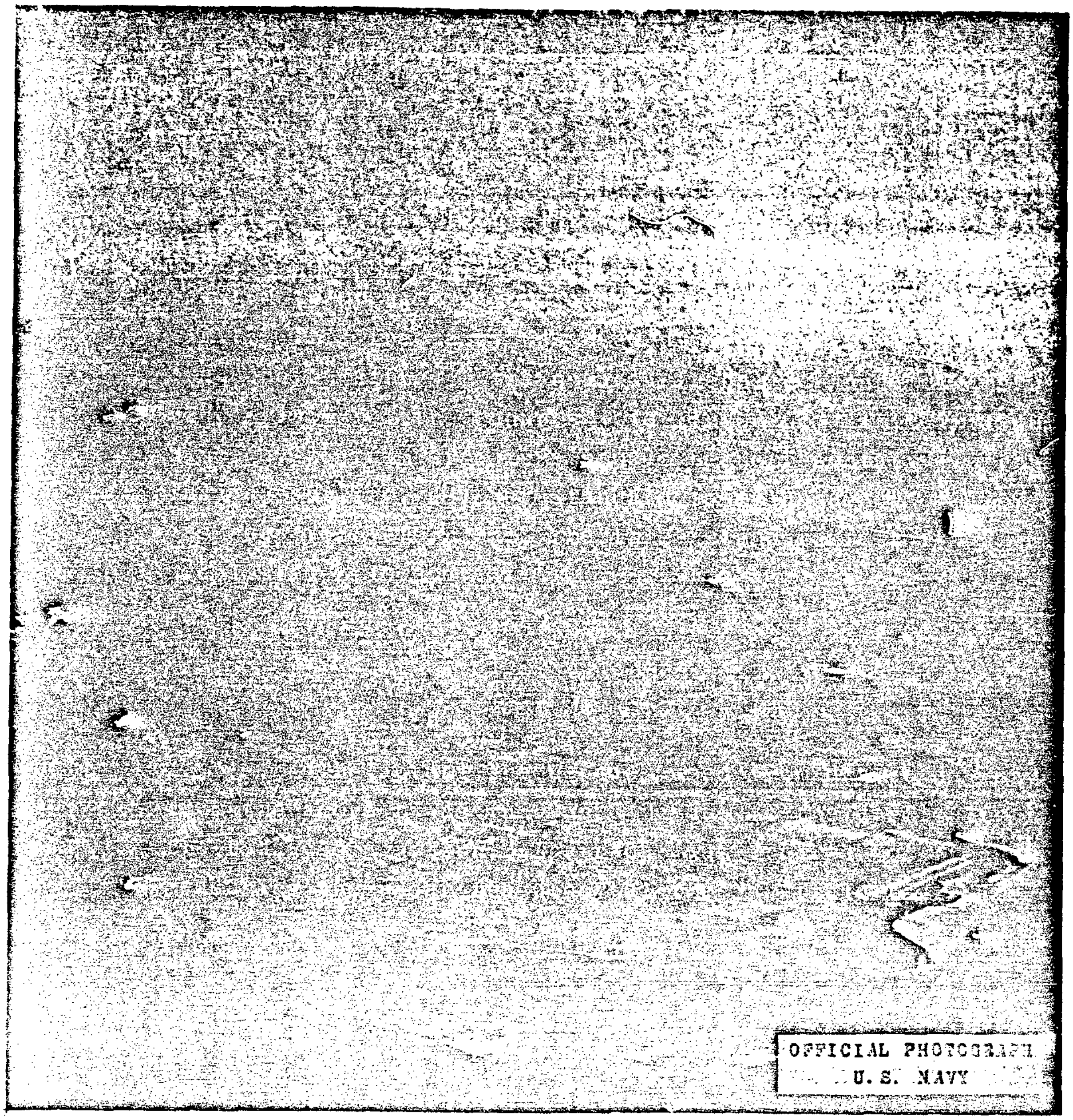


Figure 2-2. Photograph of Lompoc, California and Point Arguello Looking South-West.

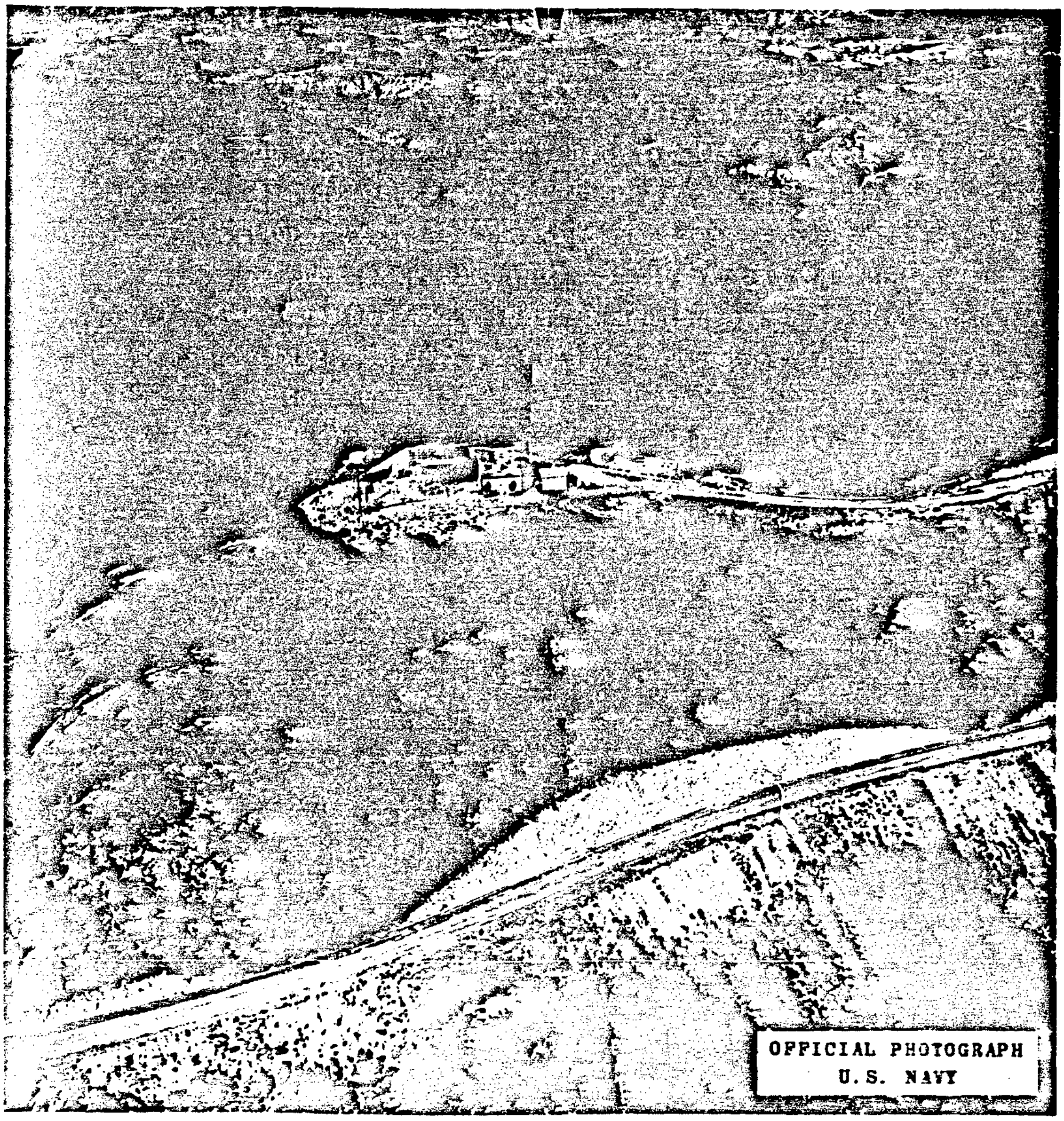


Figure 2-3. Photograph of Remote Radar Site.

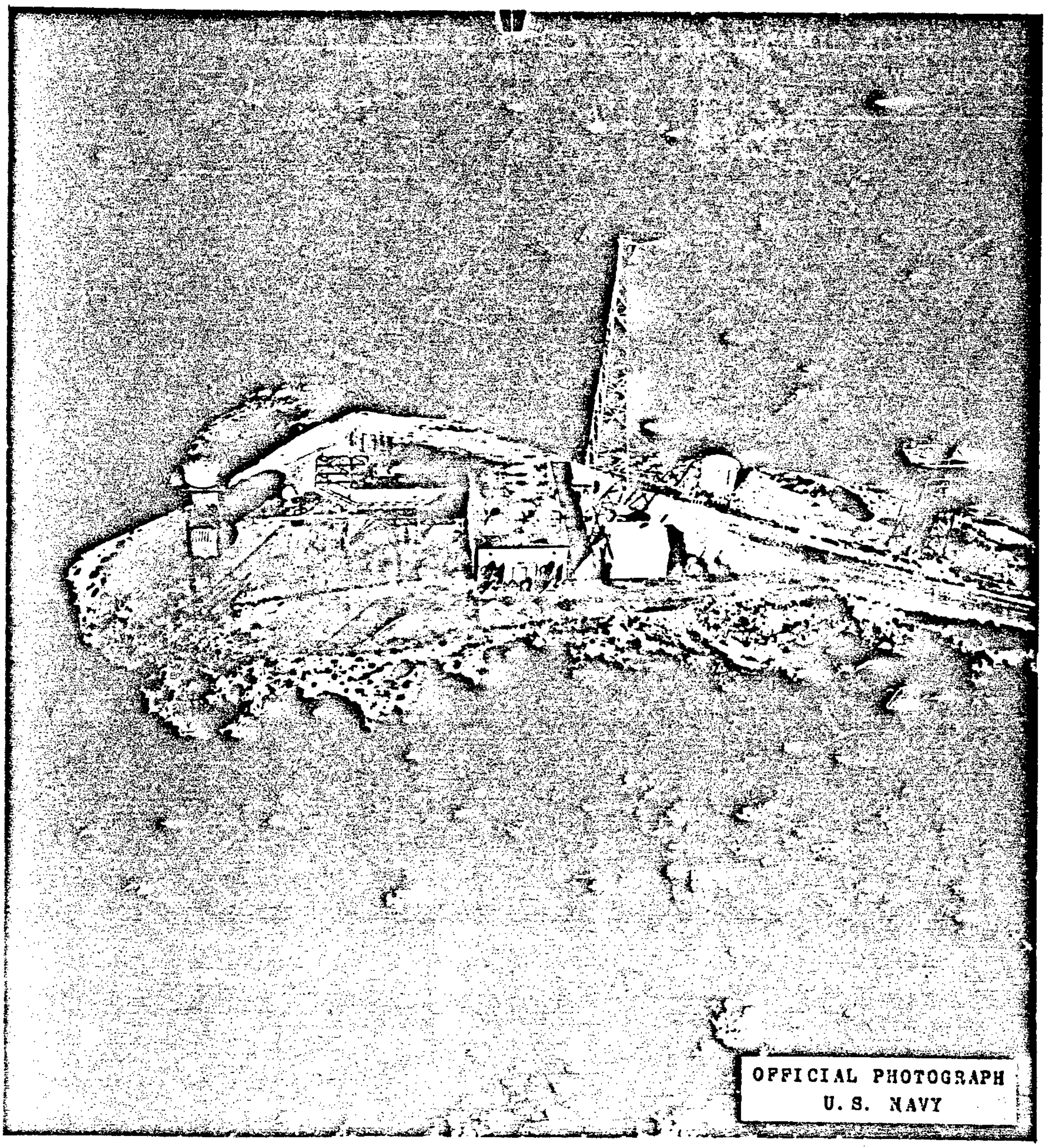


Figure 2-4. Photograph of Remote Radar Site.

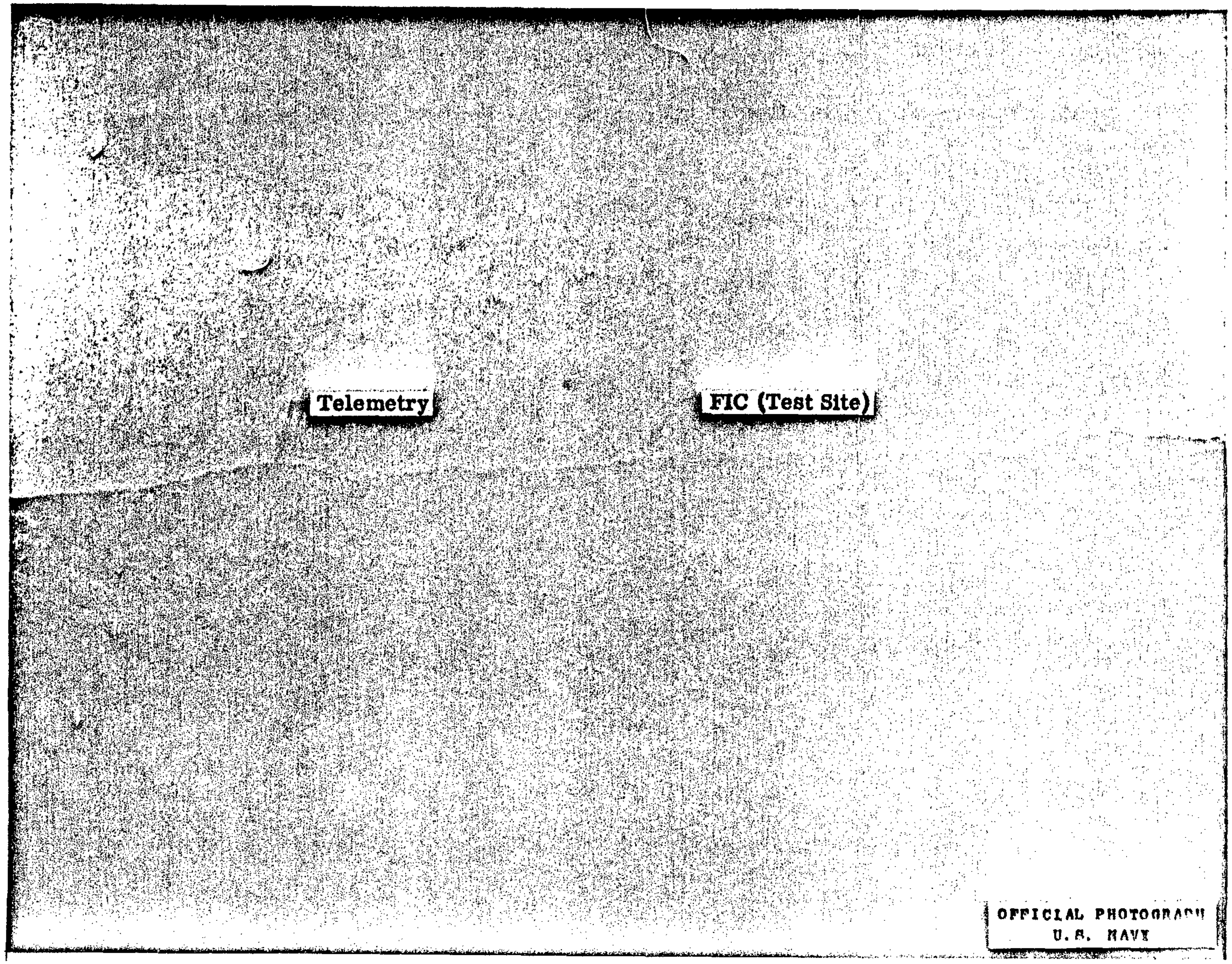


Figure 2-5. Photograph Looking to Test Site from Remote Radar Site.

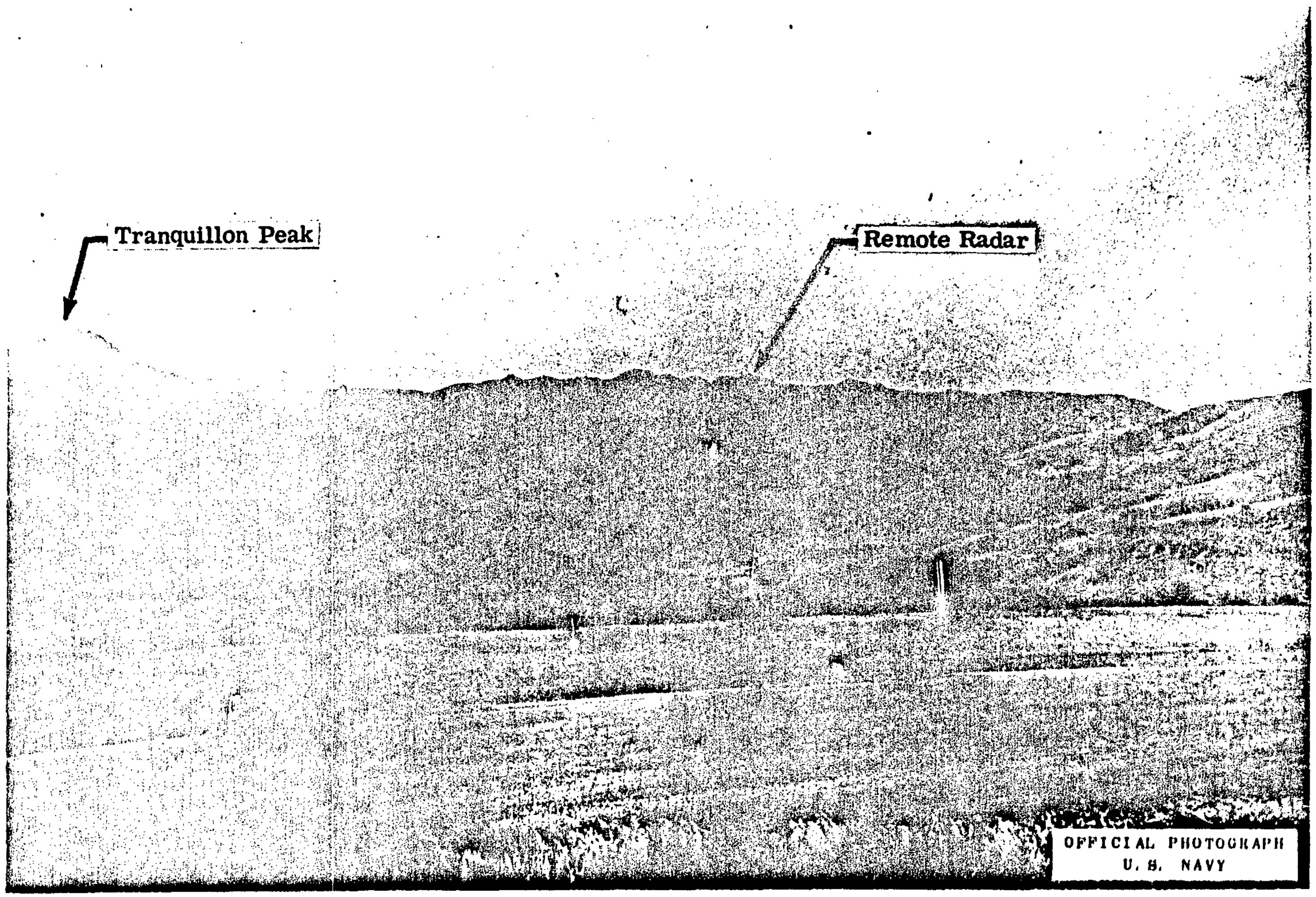


Figure 2-6. Photograph Looking to Remote Radar from Test Site.

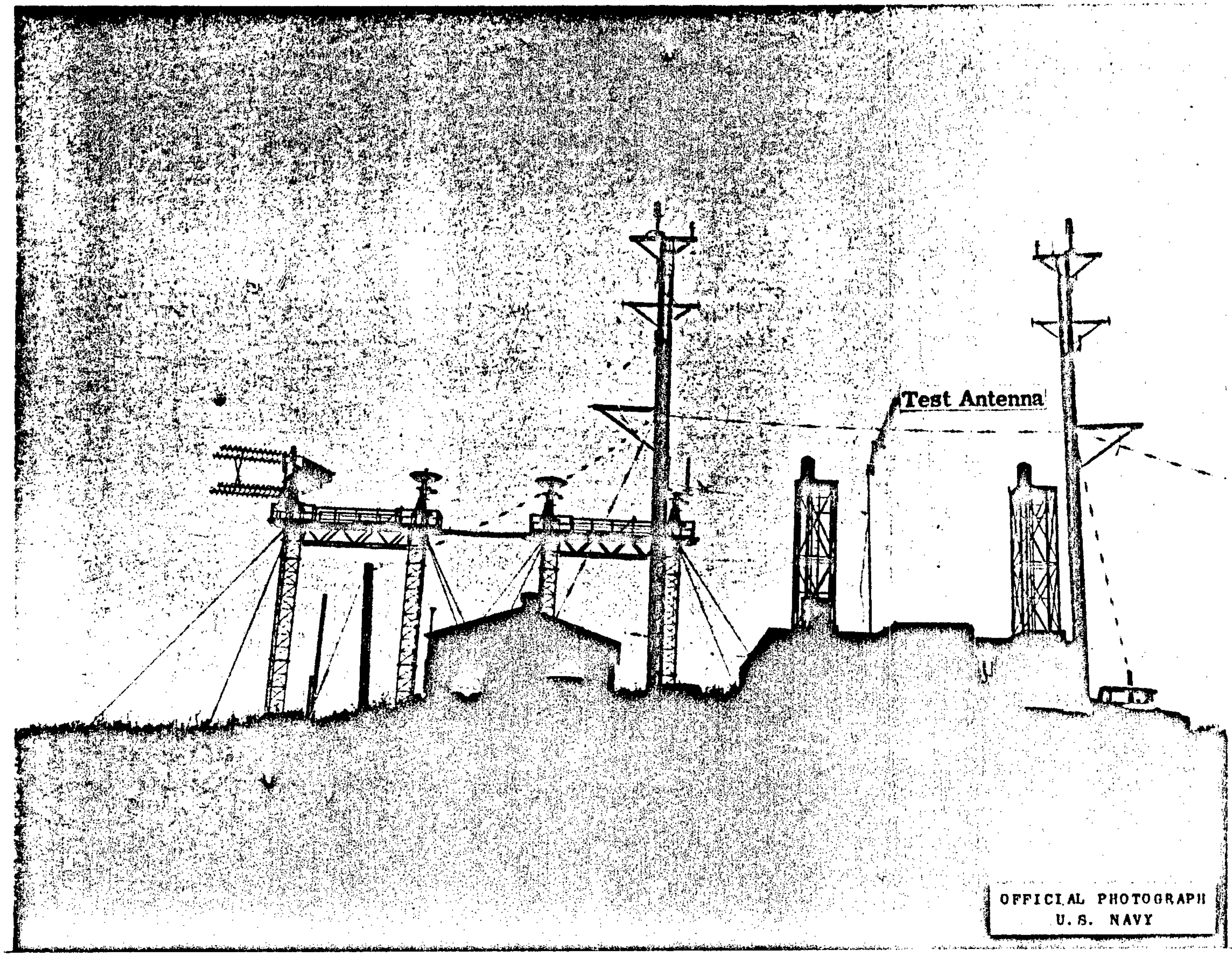


Figure 2-7. Mobile Measurement Van at Test Site (FIC).

MIL-STD-449A states that the open-field measurements shall be made at the far-field distance of the radar fundamental frequency. The far-field distance is defined as D^2/λ where D is the maximum aperture dimension of the antenna and λ is the wavelength of the fundamental test frequency. The far-field distance from the ARSR antenna at the highest standard test frequency of 1348 Mc is

$$\text{Far-field} = D^2/\lambda = \frac{(40 \text{ ft.})^2}{\frac{300}{f_{mc}} \text{ meters}} \times 3.28 \text{ ft./ meter}$$

$$= \frac{(40 \text{ ft.})^2}{\frac{300}{1348} \text{ meters}} \times 3.28 \text{ ft./ meter}$$

$$= 2190 \text{ ft.}$$

Since the Test Site is at a distance of 21,560 feet from the radar site, the test antenna was in the far-field of the fundamental and all harmonics measured.

The tall (140 ft.) microwave tower shown in Figures 2-3 and 2-4 was not in the line of sight between the radar antenna and the test site. This tower is directly in line between the radar antenna and Tranquillon Peak.

The terrain for both sites is arid, barren, and mountainous. An analysis of the soil would probably show it to be of ore-bearing composition.

For most of the spectrum signature measurements, the mountains were shrouded in fog during the morning hours. However, the Radar and Test Sites located on the peaks were usually above the fog in the morning. In the late afternoon and evening, a wet, dripping fog would usually move into the sites. Winds appeared to be continuous on the mountain peaks. Wind velocities were at a minimum in the morning hours and at a maximum during the early evening hours.

Section 3

DESCRIPTION OF MEASURED EQUIPMENT

The original Air Route Surveillance Radar, designated as ARSR-1, was designed to be incorporated into the civil airways system structure as an aid to navigation. The ARSR-1 is a pulse type radar which consists of dual transmitting, receiving, and moving target indication channels to permit constant surveillance of aircraft within a 200-mile radius of the radar site. This range has been increased in the modified ARSR-1 (ARSR-1B-A). The modified ARSR-1 includes an Amplitron rf amplifier in addition to the magnetron and its associated circuits. A four-port waveguide switch and an rf dummy load enables one channel to radiate directly from the antenna while the remaining channel can be completely energized and loaded into the dummy load for maintenance purposes. An electronic map of the region being scanned by the radar antenna is displayed on the PPI's. Normal, integrated normal, or MTI video can be displayed.

The nominal system characteristics for the ARSR-1 radar are tabulated below. These characteristics are essentially those of the ARSR-1B-A radar located at Point Arguello, California, with the exception of the power output. Radar power output with the Amplitron rf amplifier incorporated in the circuit is approximately 12 db greater than the magnetron output.

RADAR SYSTEM CHARACTERISTICS

GENERAL

Nominal Range - - - - - - - -	200 Nautical Range
(ARSR-1B-A) - - - - - - - -	Has a greater range
Frequency Band- - - - - - - -	1280-1350 Mc
Peak Power	
(Magnetron Output) - - - -	500 kw minimum, 600 kw maximum
(Amplitron Output) - - - -	A nominal 10 db greater than the magnetron output
Pulse Width - - - - - - - - -	2 μsec
Repetition Rate (PRF) - - -	360 pps
Cancellation System - - - -	Coherent Type, 3 pulse comparison with velocity shaping

ANTENNA

Array Dimension - - - - - - -	40 x 11 feet compound curved
Polarization - - - - - - - - -	Horn feed with choice of horizontal linear or circular
Beam Width (half power)- - -	Azimuth 1.35° $\pm$ 0.1° Elevation 6.0° $\pm$ 0.3°
Elevation Pattern- - - - - -	Cosecant - squared from 5.5° to 52.5° normalized to 2.5°
Gain - - - - - - - - - - - - - -	34.3 db $\pm$ 0.25 db
Sidelobe Attenuation - - - - -	At least 24 db down
Backlobe Attenuation - - - - -	At least 30 db down
Integrated Cancellation Ratio (Circular Polarization) - -	More Than 24 db (Calculated)
Rotary Joint - - - - - - - - -	Dual (Radar and IFF)
Azimuth Rotational Speed - -	6 rpm clockwise
Also - - - - - - - - - - -	9 and 12 rpm at Pt. Arguello
Beam Tilt Adjustment - - - -	From -1° to +5° by means of manually operated worm-drive screw

TRANSMITTING SYSTEM

Source of RF Power - - - - - -	Magnetron oscillator Type 5J26
Frequency Range - - - - - - -	1280 - 1350 Mc
Type of Frequency Control- -	Manual tuning of magnetron cavity
Type of Emission - - - - - - -	Pulsed
Duty Cycle - - - - - - - - - -	0.00072

RF SYSTEM

Over-all VSWR - - - - - - - -	1.3:1 (Maximum)
Duplexers - - - - - - - - - -	Ferrite circulator and 6322 tube
Mixer	
AFC Crystal - - - - - - - - -	1N21C
Signal Crystal - - - - - - -	1N21E
Noise Figure (Over-all) - -	6.7 db average measured
Waveguide Switch - - - - - - -	Less than -85 db crosstalk between channels

RECEIVING SYSTEM

Type - - - - - - - - - - - - - -	Superheterodyne
Mixer - - - - - - - - - - - - -	Broad-band crystal matched to waveguide
Local Oscillator (Stalo) - -	2C40 Lighthouse Triode with AFC, tuned above magnetron frequency, manually controllable
Stalo Frequency - - - - - - -	1270 - 1390 Mc
AFC Pull-in range - - - - - -	$\pm$7 Mc
AFC desensitization range- -	50 - 200 kc
Intermediate Frequency - - -	30 Mc $\pm$ 0.5 Mc
Bandwidth MTI - - - - - - - -	3 Mc $\pm$ 0.5 Mc at 3 db points
Bandwidth Normal - - - - - -	Between 830 kc and 1.125 Mc

RECEIVING SYSTEM (Cont'd)

Normal Detector- - - - - - -	Crystal Diode, nonlimiting AM detector
Sensitivity	
Normal Channel - - - - - - -	-109 dbm ± 2 dbm
MTI Channel - - - - - - - - -	-108 dbm ± 2 dbm
Integrated Normal Channel -	-111 dbm
Video Integration Gain - - -	20 db
MTI Feature - - - - - - - - -	Dual clutter cancellers with adjustable feedback
Anti-Clutter Circuits - - -	IAGC, STC, FTC
Sensitivity Time Control (Normal and MTI)	
Amplitude - - - - - - - - -	Adjustable to 80 db (30 db common)
Duration - - - - - - - - - -	Adjustable from 20 to 1000 μsec
Flat - - - - - - - - - - - -	Adjustable from 30 to 720 μsec
Fast Time Constant (Normal Receiver only)- - -	1.5 μ sec in Position 1 0.5 μ sec in Position 2
Instantaneous AGC (Normal Receiver only)- - -	Breaks up clutter areas to permit detection of aircraft appearing in or superimposed on clutter

MOVING TARGET INDICATION

Modes of Operation - - - - -	1. Canceller No. 1 2. Canceller No. 2 3. Double cancellers in cascade without feedback 4. Double cancellers in cascade with feedback (normal operation)
Delay Line - - - - - - - - - -	Quartz Triple Delay Line, 2777 μsec, ± 1%, each line matched to within ± 0.2 μsec, 2 for MTI, 1 for video int.
Pulse to Pulse Jitter- - - -	Less than 7.0 millimicroseconds
Video Cancellation Ratio - -	33 db each canceller
Over-all subclutter visibility	Greater than 27 db at 40 miles
Cancellation Ratio (overall)	Greater than 33 db at 40 miles
Velocity Response- - - - - -	Response capability of being adjusted better than that obtained in a single canceller, to below that obtained in a double canceller without feedback

Figure 3-1 is a block diagram of the rf system of the ARSR-1B-A radar. Since both channels are identical, only one channel is shown with the common equipment. The transmitting system of each channel of the ARSR-1B-A equipment includes an Amplitron rf amplifier in addition to the magnetron and its associated circuits in the ARSR-1 radar. The Amplitron functions as a saturated amplifier that increases the power of the magnetron rf pulses by approximately 10 db. In addition to performing its normal functions, the trigger system in each channel of the ARSR-1B-A synchronizes the firing of the Amplitron with that of the magnetron. The Amplitron trigger circuits develop the pulses necessary to synchronize the triggering of the Amplitron with that of the magnetron. Such synchronization insures that rf output of the magnetron is available at the input to the Amplitron 0.1 μsec before the Amplitron is fired. In order to achieve this synchronization between the firing of the magnetron and that of the Amplitron, it is necessary to compensate for the inherent variable anode delay of the thyratron switch tubes used in the Amplitron and magnetron modulators. Anode delay times for these tubes vary between 0.5 and 2.0 μsec. To compensate for these variable delays, a sample of the output pulse from each switch tube is applied to trigger synchronizing circuits that sense the difference in time between the two pulse samples over a given period of time. When the time between the two pulses exceeds the predetermined limit, the synchronizing circuits adjust the time of application of the Amplitron modulator trigger pulses to the switch tube in the Amplitron modulator and therefore, maintain the desired time between the Amplitron and the magnetron triggers. Figure 3-2 is a block diagram which shows the points of pulse sample in the transmitting system. The trigger system and time relationships are illustrated in Figures 3-3 and 3-4. In the absence of an Amplitron trigger, the rf signal from the magnetron traverses the rf circuit of the Amplitron and is fed to the rf system

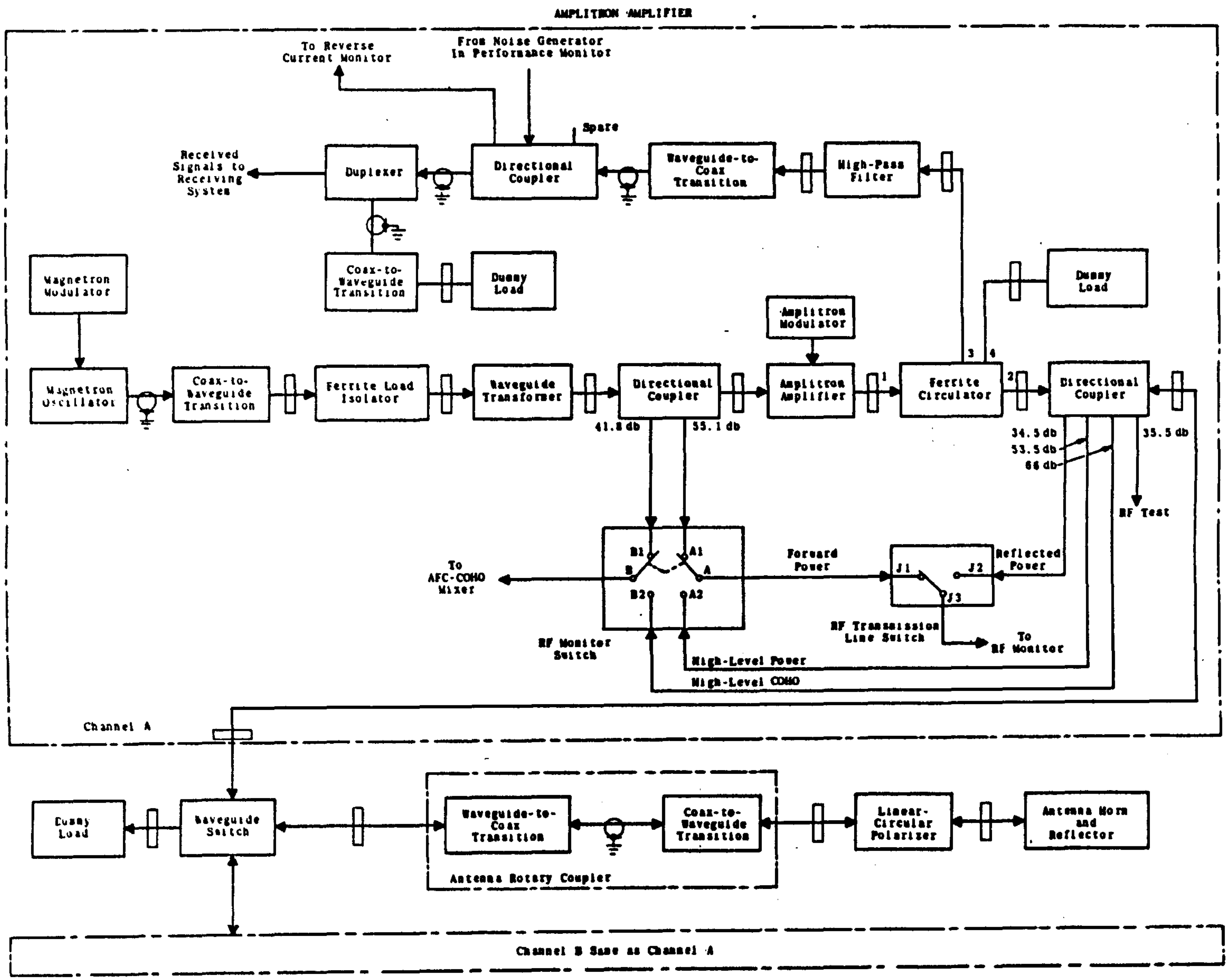


Figure 3-1. ARSR-1B-A Simplified Block Diagram.

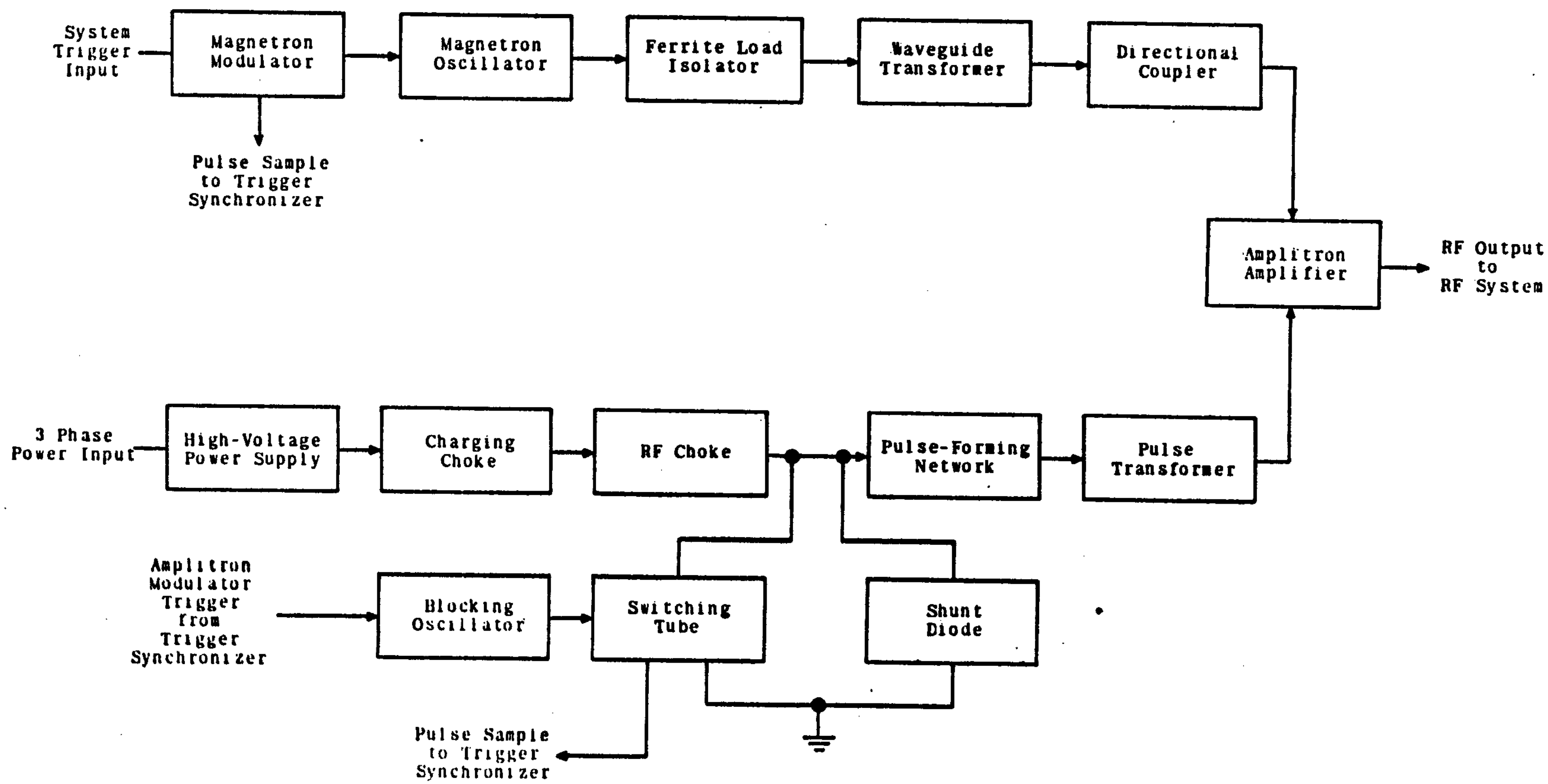


Figure 3-2. Transmitting System, Block Diagram.

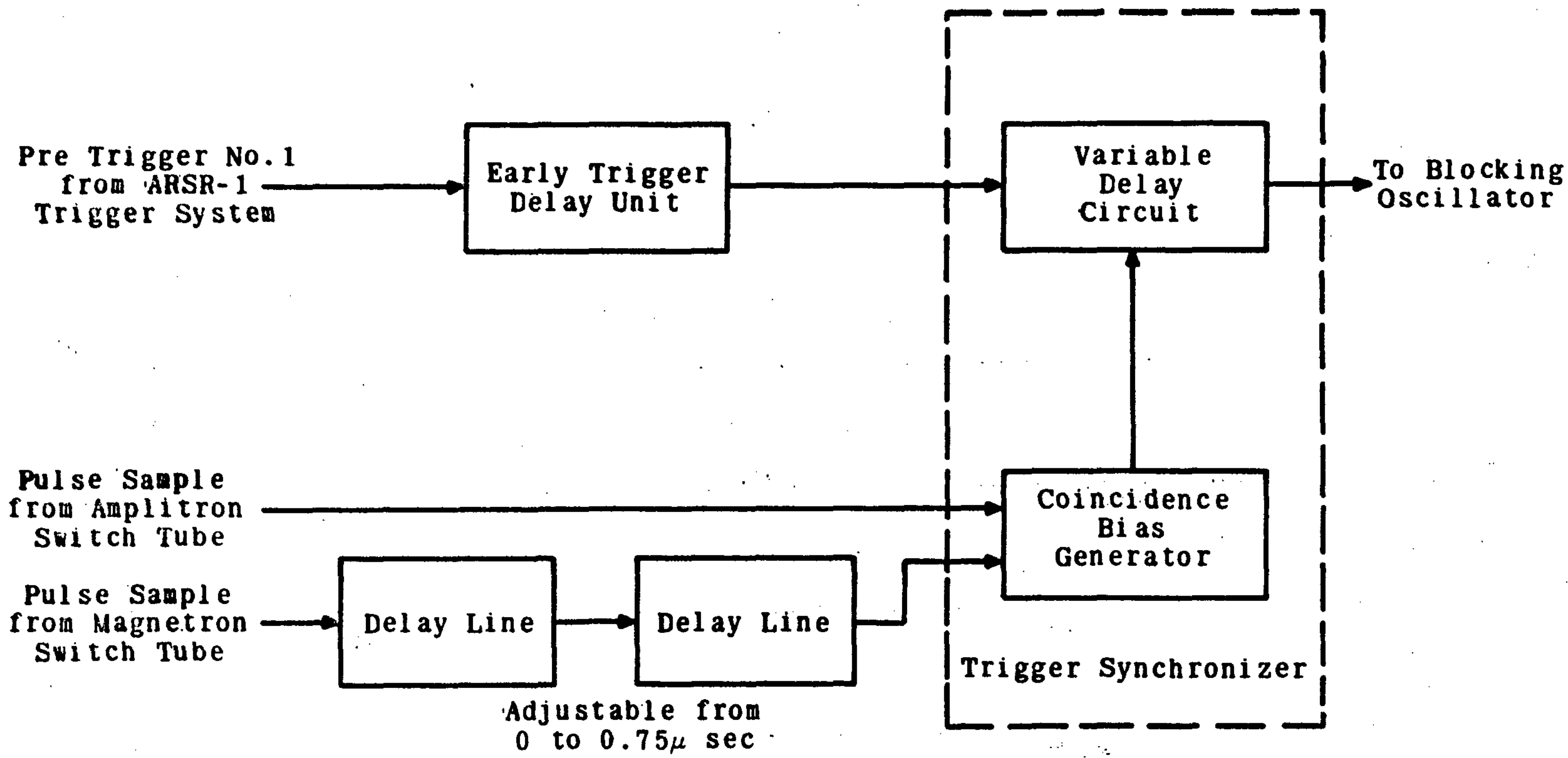


Figure 3-3. Trigger System, Block Diagram.

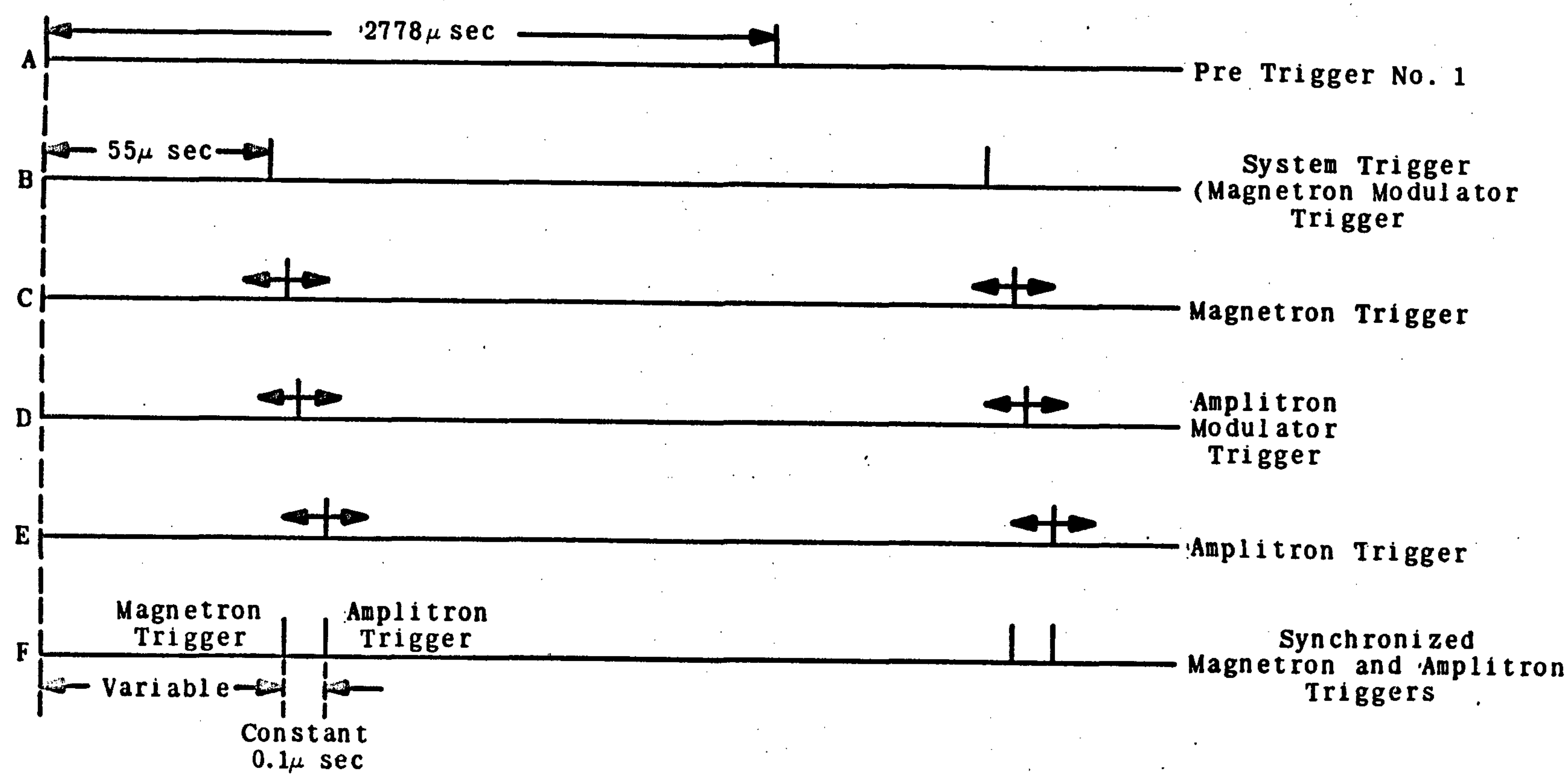


Figure 3-4. Trigger Time Relationship.

without any change in frequency or gain in amplitude. This makes it possible to operate the ARSR-1B-A equipment with the output from the magnetron only.

ARSR-1B-A common channel components shown in Figure 3-1 are identical to the components common to both channels in the ARSR-1, except that the ARSR-1B-A antenna rotary coupler and the waveguide run between the waveguide switch and the antenna pedestal are pressurized. The rf components used in Channel A and Channel B of the ARSR-1 rf system are similar to the components used in the ARSR-1B-A equipment. In addition the ARSR-1B-A system includes a ferrite circulator and high-pass filter.

The rf output of the magnetron oscillator is fed through a section of 1 5/8-inch rigid coaxial transmission line to a coaxial-to-waveguide transition. The transition transfers the rf energy from the coaxial mode of the transmission line to the waveguide mode in a half-height waveguide. The output of this transition is applied to a ferrite load isolator.

This ferrite load isolator offers a low impedance to the rf energy from the coaxial-to-waveguide transition and a high impedance to any reflected energy from the waveguide transformer to which the output of the isolator is applied. This minimizes the effect of any mismatch in the rf system upon the operation of the magnetron oscillator. The low impedance of the ferrite load isolator output is matched to the impedance of a full-height waveguide by a waveguide transformer. The output of the transformer is applied to a directional coupler.

This directional coupler couples the rf energy from the waveguide transformer to the Amplitron and also applies two attenuated output signals to the RF MONITOR.

The high-power rf output of the Amplitron is applied to connection 1 of the ferrite circulator. The rf output of the Amplitron is circulated from connection 1 to connection 2, and fed through the directional coupler and the common channel rf components to the antenna. Subsequent echo signals received by the antenna are fed through the common-channel rf components and directional coupler to connection 2 of the circulator, circulated to connection 3 and then applied through various components to the receiving system. Any rf energy reflected into connection 3 of the circulator from the receiving system is circulated to and absorbed by the dummy load on connection 4. The circulator, therefore, performs the function of a duplexer. The high-pass filter from connection 3 of the circulator is designed to pass all signals above approximately 1150 Mc. Figure 3-5 is a photograph showing the ferrite circulator and the following directional coupler of Channel B. This photograph shows the location of the ferrite circulator connections and the 66.2 db connection of the directional coupler. The lead from the 66.2 db connections goes to the HP-430C power meter used to monitor power in the spectrum signature tests.

The rf energy leaving connection 2 of the ferrite circulator travels through the directional coupler to the waveguide switch. This switch functions to deliver the rf energy to either the dummy load or the antenna. Figure 3-6 is a photograph of the waveguide switch showing the inputs from Channel A, Channel B, dummy load and antenna.

The rf energy to be radiated leaves the waveguide switch and travels through the antenna rotary coupler to the Linear-Circular polarizer. Either linear or circular polarization may be selected.

The linear-circular polarizer is a device that applies either linearly or circularly polarized rf energy to the reflector. A linearly polarized wave is one in which the direction of the electric field does not change except for the 180 degree phase reversal during one cycle. The electric field in a linearly polarized wave may be horizontal, vertical, or any other angle, but it must remain the same. A circular polarized wave is one

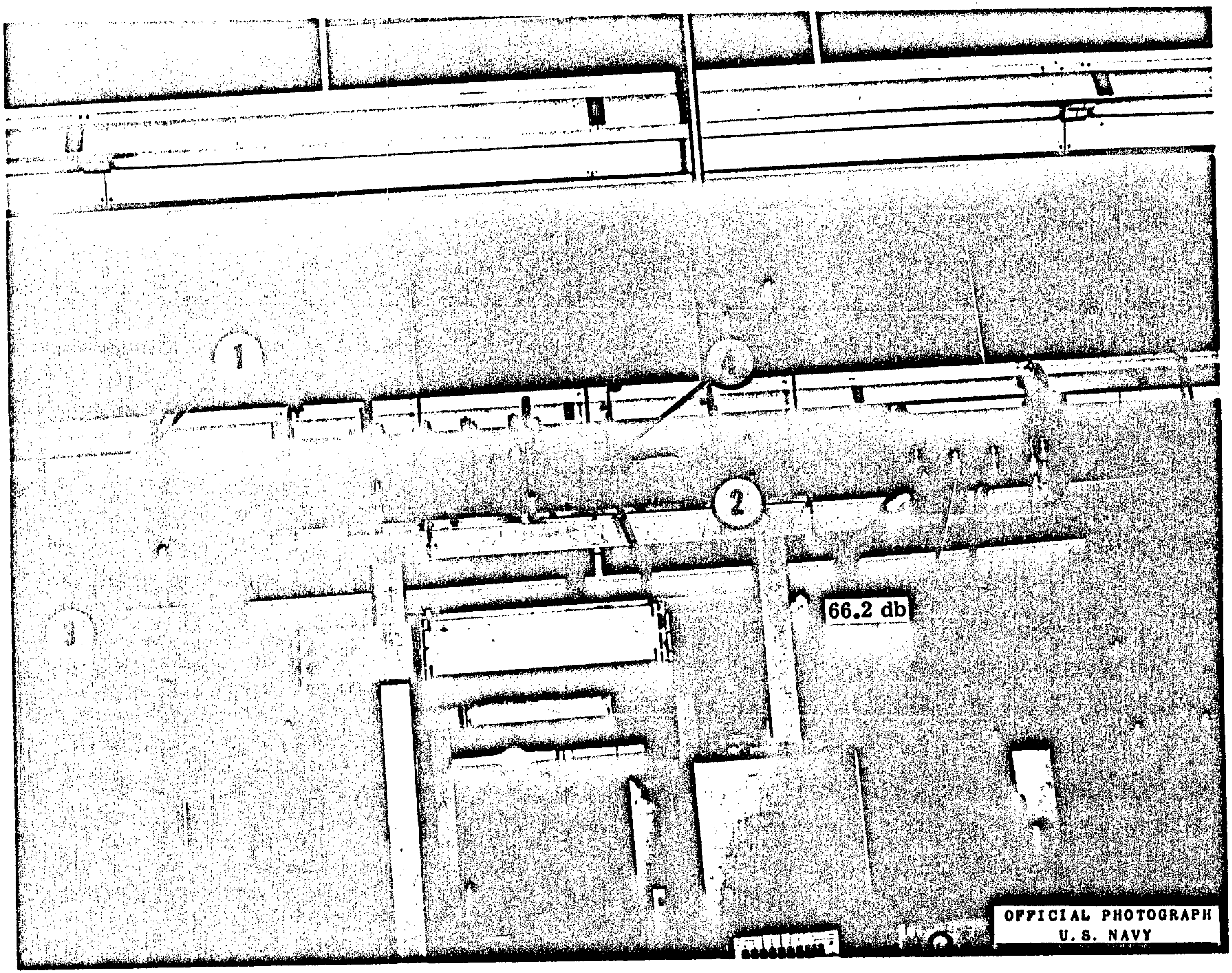


Figure 3-5. Photograph of Ferrite Circulator and Directional Coupler.

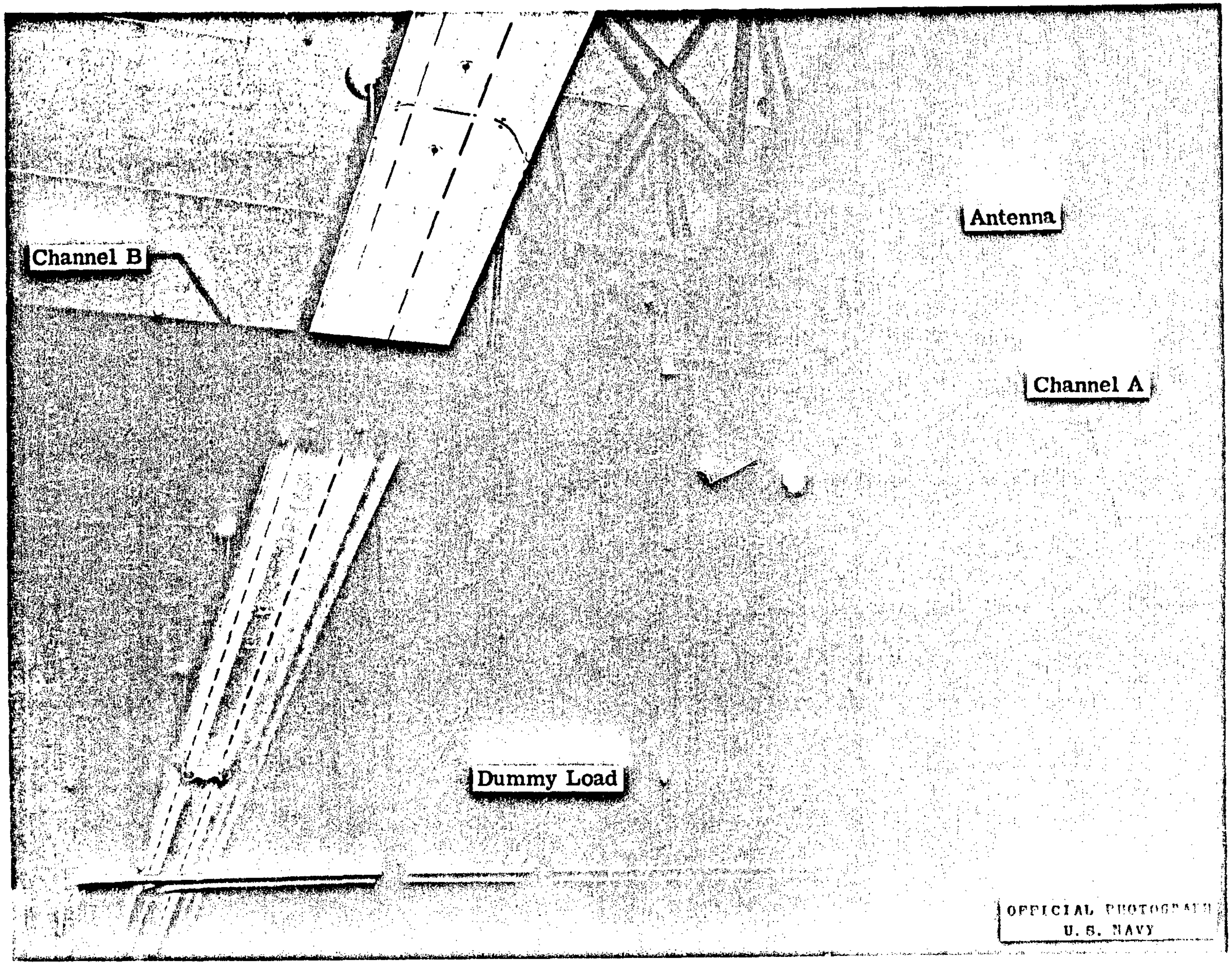


Figure 3-6. Photograph of Wave Guide Switch.

in which the direction of the electric field rotates in a circular motion and has a constant amplitude throughout its rotation cycle. When circular polarization is used, no signal will be received when the return echo is rotating in the opposite direction. Echoes from symmetrical targets, such as a flat metal sheet or a sphere, return to the antenna rotating in the opposite direction and are therefore, not received. Raindrops, being roughly symmetrical spheres, return echoes that are rotating in the opposite direction and are thereby not as readily received as those echoes from nonsymmetrical bodies. As a consequence, circular polarization is used to reduce rain clutter signals. Since some loss occurs in echoes from all targets because of the presence of symmetrical components, circular polarization is not ordinarily used unless an advantage is realized due to the presence of rain.

In view of this, linear (horizontal) polarization was used for nearly all spectrum signature measurements. The Linear-Circular Polarizer is seen in the close-up photograph of the antenna in Figure 3-7. Figure 3-8 is a photograph of the ARSR antenna taken from the platform just below the FPS-6 antenna.

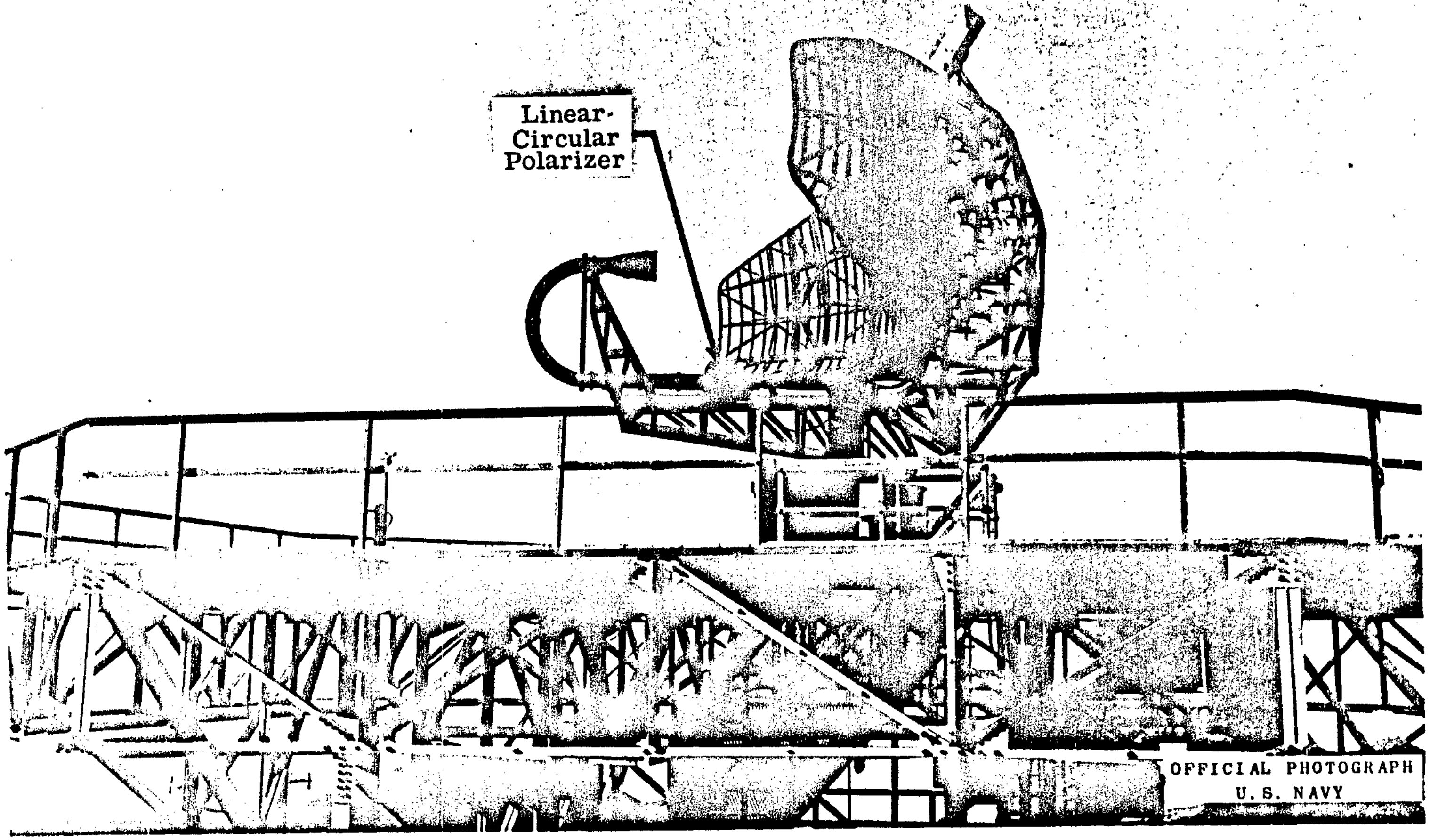


Figure 3-7. Photograph of ARSR-1B-A Antenna (close up).

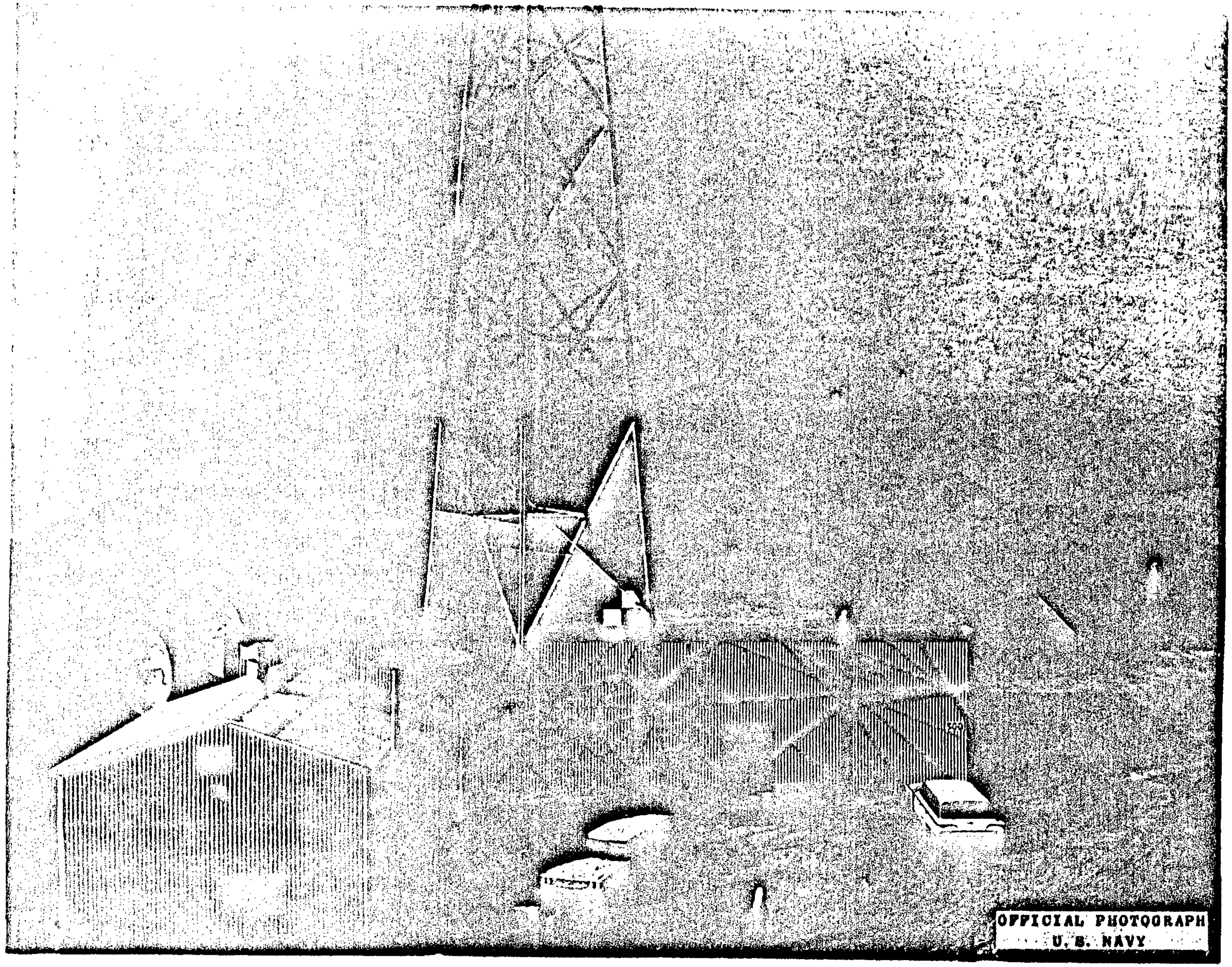


Figure 3-8. Photograph of ARSR-1B-A Antenna (long shot).

Section 4

TEST EQUIPMENT

A large quantity of the test equipment used in the spectrum signature measurement was housed in a Frederick Research Corporation Mobile Measurement Van. This van is shown in Figure 2-7 parked at the Test Site for the far-field measurements. Shielding for this type of van has been measured and recorded. Additional test equipment was supplied from the home laboratory of Jansky & Bailey. In some instances, site equipment may be used when it is available. Any special equipment needed, which is not ordinarily used in spectrum signature measurements and therefore may not be part of either firm's equipment list, is procured or fabricated by Jansky & Bailey. Equipment purchased on prior tasks is also used when needed. A record is kept of test equipment calibration and bandwidth. This record is kept continually up to date.

4.1 MOBILE MEASUREMENT VAN TEST EQUIPMENT

EQUIPMENT	MODEL	SERIAL NO.	FREQUENCY RANGE
SIGNAL GENERATORS			
General Radio	1001-A	3599	5kc-50Mc
Hewlett-Packard	608C	369-02403	10Mc-480Mc
Hewlett-Packard	612A	299-01688	450Mc-1230Mc
Hewlett-Packard	614A	211-03092	800Mc-2100Mc
Hewlett-Packard	616B	148-01241	1800Mc-4200Mc
Hewlett-Packard	618B	151-02920	3800Mc-7600Mc
Hewlett-Packard	620A	216-02566	7000Mc-11,000Mc
Polarad	MSG-1	366	950Mc-2400Mc
Polarad	MSG-2A	396	2150Mc-4600Mc
FIELD INTENSITY METERS			
Stoddart	NM-10A	239-32	14kc-250kc
Stoddart	NM-20B	251-13	150kc-25Mc
Stoddart	NM-30A	243-2	20Mc-400Mc
Stoddart	NM-50A	249-22	375Mc-1000Mc
Stoddart	NM-62A	356-2	1.0kMc-10kMc

EQUIPMENT	MODEL	SERIAL NO.	FREQUENCY RANGE
RECEIVERS			
National	HRO-60R	868	50kc-30Mc
Nems-Clarke	1905	3	30Mc-900Mc
Nems-Clarke	REU-300B	229	
PANADAPTORS			
Panoramic	SA-8B2-T200	26J111	455kc
Panoramic	SA-3-T3000C1	15H407	21.4Mc
SPECTRUM ANALYZER			
Polarad	SA-84	214/197	10Mc-40,880Mc
POWER METER			
Hewlett-Packard	430C	261	
THERMISTOR MOUNTS			
Hewlett-Packard	477B		10Mc-10,000Mc
Hewlett-Packard	X487B		8200Mc-12,400Mc
Hewlett-Packard	P487B		12,400Mc-18,000Mc
Hewlett-Packard	K487B		18,000Mc-26,500Mc
FREQUENCY METERS			
Lavoie	LA-70A	202	10kc-3000Mc
Narda	802B	248	2350Mc-10,500Mc
Hewlett-Packard	X532A		8200Mc-10,500Mc
Hewlett-Packard	K532A		12,400Mc-18,000Mc
Hewlett-Packard	P532A		18,000Mc-26,500Mc
ATTENUATORS			
Weinschel	50-5	52492	DC-1kMc
Weinschel	50-10	54101	DC-1kMc
Weinschel	50-20	54052	DC-1kMc
Weinschel	50-40	54351	DC-1kMc
Weinschel	50-50	52561	DC-1kMc
Weinschel	210-5	17933, 17936	1-10kMc
Weinschel	210-10	13825	1-10kMc
Weinschel	210-20	14823, 17397	1-10kMc
ANTENNAS			
Stoddart, Loop	90117-3		
Stoddart, Loop	90114-3		
Stoddart, Rod	90291-2		
Stoddart, Loop	90298-2		
Stoddart, Loop	91077-2		
Stoddart, Dipole	90333-2		
Stoddart, Dipole	90330-3		

EQUIPMENT	MODEL	SERIAL NO.	FREQUENCY RANGE
ANTENNAS (continued)			
Polarad, Horn	CA-L	195	
Polarad, Horn	CA-S	196	
Polarad, Horn	CA-M	182	
Polarad, Horn	CA-X	179	
Polarad, Reflector	CA-R	216	
Polarad, Omni	CA-B	178	
Polarad	KU	114	
Polarad	K	115	
WAVEGUIDE EQUIPMENT			
FXR Waveguide	WG34A	129	
FXR Waveguide	C634A	181	
FXR Waveguide	H634A	133	
FXR Waveguide	S634A	133	
Aircom Waveguide	BL02	106	
FXR Waveguide to Coax	W601B	629,630	
FXR Waveguide to Coax	C601B	623,629	
FXR Waveguide to Coax	H601B	897,898	
FXR Waveguide to Coax	S601B	816,848	
Aircom Waveguide to Coax			
FILTERS			
Stoddart	LP11148		25Mc low-pass
Microphase	LP50AB	601	50Mc low-pass
Microphase	LP-100AB	508	100Mc low-pass
Microphase	LP-200	503	200Mc low-pass
Microphase	LP-400	1119	400Mc low-pass
Microphase	LP-600	502	600Mc low-pass
Microphase	LP-1000	506	1000Mc low-pass
Microphase	LP-2000	503	2000Mc low-pass
Microphase	LTP-4000	506	4000Mc low-pass
Microphase	LTP-8000	522	8000Mc low-pass
Microphase	LTP-12,000	525	12,000Mc low-pass
Microphase	LTP-12,000	501	12,000Mc low-pass
Microphase	HT-12,000	501,504	12,000Mc high-pass
MISCELLANEOUS EQUIPMENT			
Kay Mega-Sweep	100A	18506	50kc-1000Mc
Tektronix Scope	545A	021615	
Hewlett-Packard (VTVM)	400H	7396	
Hickock Tube Tester	539B	18212470	
Simpson (Multimeter)	260	5888	
Dumont Camera Mount	2620	5433	
Polaroid Camera	2620	B025292	
Esterline Angus Recorder		126630	
HP Transfer Oscillator	540B	129-01700	
Sanborn Amplifier	150-1400		
Sanborn Recorder	151	973	
Microlab Power Divider	DA-3FN		
Autograph XY Recorder	M-135		
Transit, David White	8300	105X	

4.2 ADDITIONAL TEST EQUIPMENT

Listed below is additional equipment supplied by the home laboratories of Jansky & Bailey, GFE and the Naval Missile Facility.

J&B TEST EQUIPMENT

CHOPPER			
Jansky & Bailey			1000cps Square Wave
DIRECTIONAL COUPLER			
Narda	3022	202	1.0kMc-4.0kMc
MOTOR			
	Variable Speed		
TRANSCEIVER			
RCA (2)	Citizens Band		

GOVERNMENT FURNISHED EQUIPMENT

SIGNAL SAMPLER			
Microlab	HY Series N		
FILTERS (HIGH-PASS)			
Microlab	HC-02N		200Mc
Microlab	HC-04N		400Mc
RLC Electronics	F-20		800Mc
ATTENUATOR			
Weinschel (20db,20W)	693-20	51310	
CABLE			
Prodlein (100')	RG-260/U		

NAVAL MISSILE FACILITY

COUNTER		
Hewlett-Packard	522B	125-04870

4.3 COMPONENTS PROCURED

The following component was procured for this task. Small components such as connectors, crystals, film, recording paper, miscellaneous hardware items, etc., are not listed.

ADJUSTABLE ATTENUATOR

General Radio	GR-874-GA

4.4 FABRICATION OF SPECIAL EQUIPMENT

In an experimental pulse count test, it was found that a pulse generator or some other threshold device was needed in order to isolate the receiver from the counter. A Tektronix scope used as a threshold device was found to work very well in these tests. However, in order to have a back up threshold device for the pulse count test or the ARSR radar in Point Arguello, a transistorized Schmitt trigger circuit was built in the J&B laboratory.

4.5 CALIBRATION OF TEST EQUIPMENT

All of the test equipment such as signal generators, field intensity meters, power meters, frequency meters and attenuators is either calibrated or checked shortly before each task assignment for the collection of spectrum signatures. During the course of the measurements, a continual cross check between instruments is made wherever possible in order to maintain a check on the accuracy of the equipment. If, during the measurements, an instruments accuracy becomes suspect, the instrument is either replaced or recalibrated. At the completion of a task and before the van is moved from the measurement site, all signal generators 0 dbm settings are checked against a thermal power meter. Calibrated attenuators are also checked before leaving the measurement site.

Measurements such as cable losses and coupling factors of signal samplers and directional couplers are made during the course of the measurements or just prior to leaving the measurement site.

Data are discussed and tabulated below on mobile van shielding, van equipment calibration dates, test antenna gains, and cable losses.

4.5.1 Mobile Van Shielding

Shielding attenuation versus frequency for this type of measurement van is listed below.

Frequency (Mc)	Attenuation (db)
0.1	66
1.0	46
18.0	0
450.0	55
900.0	45
1200	52
2200	43
4200	41
6000	51
8000	>40
10000	>40

This hole in the shielding at 18 Mc is very narrow. Shielding is greater than 40 db at all other frequencies.

4.5.2 Van Equipment Calibration Dates

Periodic calibrations are made on a large portion of the Mobile Van test equipment. The dates of the last calibration are tabulated below. This equipment was used on Task No. 11 between December 2, 1962, and December 21, 1962.

EQUIPMENT	SERIAL NO.	DATE OF CALIBRATION
SIGNAL GENERATORS		
General Radio	3599	11/8/62
Hewlett-Packard	211-03092	10/31/62
Hewlett-Packard	148-01241	10/30/62
Hewlett-Packard	151-02920	11/1/62
Hewlett-Packard	216-02566	11/2/62

EQUIPMENT	SERIAL NO.	DATE OF CALIBRATION
SIGNAL GENERATORS (cont'd)		
Polarad	366	11/5/62
Polarad	396	11/1/62
FIELD INTENSITY METERS		
Stoddart	239-32	10/30/62
Stoddart	251-18	11/1/62
Stoddart	248-2	10/31/62
Stoddart	249-22	10/5/62
Stoddart	356-2	11/16/62
POWER METER		
Hewlett-Packard	261	9/6/62
FREQUENCY METER		
Lavoie	202	11/6/62
ATTENUATORS		
Weinschel	52492	8/24/62
Weinschel	54101	8/24/62
Weinschel	54052	8/24/62
Weinschel	54351	8/24/62
Weinschel	52561	8/24/62
Weinschel	17933, 17936	7/9/62
Weinschel	13825	7/9/62
Weinschel	14823, 17397	7/9/62
MISCELLANEOUS EQUIPMENT		
Tektronix Scope	021615	10/31/62
Hewlett-Packard (VTVM)	7396	7/19/62
Simpson (Multimeter)	5888	10/17/62

4.5.3 Test Antenna Gains

The manufacturer's calibration of the gain of the test antennas with respect to an isotropic antenna are listed below. Antenna gain figures are used in computing power densities.

ANTENNA	FREQUENCY (Mc)	GAIN (db)
Tuned Dipole	200	2.2
Tuned Dipole	1000	2.2
Polarad CA-L	1000	8.1
	1200	9.7
	1300	10.3
	1500	11.2
	1750	12.4
	2000	13.6
	2200	14.5
Polarad CA-S	2000	15.1
	2200	15.9
	2500	16.8
	3000	17.8
	4000	19.8
	4300	20.4
Polarad CA-M with CA-R Reflector	4100	22.8
	4500	23.0
	5000	23.4
	5500	24.0
	6000	24.5
	6500	25.2
	7000	25.8
	7700	26.7
Polarad CA-X with CA-R Reflector	7400	27.0
	8000	27.5
	8500	28.0
	9000	28.5
	9500	29.0
	10,000	29.5

4.5.4 Cable Losses

Test and calibration cable losses must be known in order to compute the power density at the test antenna. These losses were measured by inserting the lengths of cable between a signal generator and a tuned RF voltmeter. The same indication is obtained on the receiver with and without the cable inserted. The difference in signal generator outputs is the cable loss. The net cable loss in the open-field measurements was that of a 100' of RG-260/U plus a 6' length of RG-8/U. In the power output measurement a 20' length of RG-9/U was used to connect the power meter to the directional coupler in the ARSR transmission line. These cable losses are tabulated below.

Frequency (Mc)	100' RG-260/U plus 6' RG-8/U (db)	20' RG-9/U (db)
100	1.6	
500	3.1	
1000	4.0	
1200	4.9	
1258		1.6
1298		2.1
1348		2.1
1400	5.5	
1600	5.9	
1800	6.1	
2000	6.4	
2500	7.5	
3000	8.2	
3500	9.6	
4000	10.8	
4500	12.1	
5000	13.0	
5500	13.1	
6000	13.5	
6500	15.0	
7000	14.9	
7500	17.0	
8000	15.7	
8500	16.0	
9000	16.8	
9500	17.1	
10,000	18.6	

4.6 TEST EQUIPMENT BANDWIDTHS

Bandwidth and IF frequencies of the receiving test equipment must be known when analyzing data from tests such as the Spurious Emission, Emission Spectrum, and Modulation Characteristics.

The receiving equipment used in this task included the Polarad SA-84 spectrum analyzer and the Stoddart NM-10A, NM-20B, NM-30A, NM-50A receivers.

The Polarad SA-84 spectrum analyzer has a frequency range of 10-40,880 Mc which is covered in eight bands. Spectrum analyzer intermediate frequencies are 160 Mc, 64 Mc and 500 kc. The first local oscillator is tuned 160 Mc above the signal input while the second local oscillator frequency is centered at 224 Mc. Since the bandwidth of the final narrow band amplifier is 20 kc, the resolution bandwidth of the spectrum analyzer is 20 kc.

The Stoddart NM-62A has a frequency range of 1000 Mc to 10,000 Mc which is covered in four bands. Bands 1 to 4 have frequency ranges as follows: 1.0-2.3 kMc, 2.3-4.4 kMc, 4.4-7.3 kMc, and 7.3-10.0 kMc. In bands 1 and 3, the first local oscillator is tuned above and in bands 2 and 4 below the incoming signal by 160 Mc. The second local oscillator is set at 220 Mc to give an IF frequency of 60 Mc. Receiver bandwidths of either 5.0 Mc or 0.5 Mc may be obtained by a front panel switch.

Since no spurious emissions were found below 1000 Mc, no bandwidth data on the Stoddart NM-10A, NM-20B, NM-30A and NM-50A will be given here.

Section 5

MEASUREMENTS

5.1 GENERAL

Transmitter measurements were made on the ARSR-1B-A radar according to MIL-STD-449A insofar as time permitted. All transmitter tests were made on Channel B of the radar. Task Order 11 deleted receiver measurements and the requirement for more than one test site. Antenna patterns were to be made after the far-field transmitter tests were completed through the second harmonic and then only if they could be taken with the antenna rotating at a speed of 1 rpm or less. The antenna measurements had priority over the special Pulse Count test. Far-field transmitter measurements above the second harmonic had the next priority after the Pulse Count test. Antenna speeds of 1 rpm or less could not be obtained and as a consequence, no antenna patterns were made.

The three standard test frequencies used for the spectrum signature measurements were 1257.8 Mc, 1297.8 Mc, and 1348 Mc. These may be referred to at times as the low, center (mean) and high standard test frequencies. Since the radar is manually tuned (magnetron), some slight variation in the standard test frequency is seen in the day-to-day measurement of frequency. Notation for the radar fundamental and harmonic is f_o, $2f_o$, etc. Vertical polarization of the test antenna is identified variously as Vert., VP, and V. Horizontal polarization of the test antenna is identified at times as Hor., HP, and H.

All the transmitter tests can be classified as either open-field or closed-system. MIL-STD-449A specifies that all open-field tests shall be made in the far-field of the fundamental frequency. Far-field distance between the radar and test antennas is defined as D^2/λ where D is the maximum aperture dimension of the radar antenna, and λ is the wavelength of the fundamental frequency. The test site used in this task was in the far-field for all the spurious frequencies. Closed-system tests are those that are made in the transmission line of the radar.

The numbering in this section of the report is made to correspond to the numbering in MIL-STD-449A. For instance, the transmitter Spurious Emission test is described in Section 5.2.3 in MIL-STD-449A. In this section, the Spurious Emission test is reported in Section 5.2.3. Furthermore, the measurement setup block diagram for this test is Figure 5.2.3-1 and the automatic spurious emission scans follow in Figures 5.2.3-2, 5.2.3-3, etc.

In this section, a description of the test for each measurement will be made. This will be followed by block diagrams, photographs or curves, and data sheets.

5.2 TRANSMITTER MEASUREMENTS

All open-field transmitter measurements were made in the far-field at the Test Site (FIC). These tests are listed below:

Spurious Emission	(5.2.3)
Emission Spectrum	(5.2.4)
Modulation Characteristics	(5.2.5)

The following tests were made in closed-system

Power Output	(5.2.2)
Carrier Frequency Stability	(5.2.8)

In addition, power output was monitored and recorded at frequent intervals during the open-field transmitter tests.

5.2.2 Power Output

Since the fundamental power output of the radar is measured at frequent intervals during all transmitter measurements, no formal test was made where power output was the only quantity measured. A continual measurement of power output at frequent intervals was made during the radiation tests such as spurious emission, emission spectrum, etc. Closed-system power output measurements were made at the three standard test frequencies of 1257.8 Mc, 1297.8 Mc, and 1348 Mc on Channel B of the radar. Measurements were made with a thermal type power indicator as shown in Figure 5.2.2-1.

Forward power was measured at the directional coupler output which has a nominal coupling factor of 66 db. The calibrated coupling factor was actually 66.2 db. Power meter readings taken from the HP-430C power indicator are tabulated in the data sheets under the power meter reading column. Coupling factor in the directional coupler and cable loss between the directional coupler and power meter must be added to the power meter reading to obtain the average power output. Cable loss is shown under the attenuation inserted column. Average power output in equation form is

$$\text{Power Output (avg.)} = \text{power meter reading} + \text{coupling factor} + \text{attenuation inserted}$$

From line 1 of the power output data sheet of 12/3/62

$$\begin{aligned}\text{Power Output (avg.)} &= -1.1 \text{ dbm} + 66.2 \text{ db} + 2.1 \text{ db} \\ &= 67.2 \text{ dbm}\end{aligned}$$

Peak power may be obtained from the average if the output duty cycle is known. The measured duty cycle is

$$\begin{aligned}\text{Duty cycle} &= \text{PRF (pulsewidth)} \\ &= 360 \text{ (1.8 microsecond)} \\ &= 648 \times 10^{-6}\end{aligned}$$

$$
\begin{aligned}
\text{Peak Power} &= \text{avg. power (dbm)} + 10 \log 1/\text{ duty cycle} \\
&= 67.2 \text{ dbm} + 10 \log 1/648 \times 10^{-6} \\
&= 67.2 \text{ dbm} + 31.9 \text{ db} \\
&= 99.1 \text{ dbm}
\end{aligned}
$$

Since the forward power was sampled, a correction must be made for reflected power to determine the actual power output. The measured VSWR for each of the three standard test frequencies and the correction to the power output as shown above is tabulated below.

Frequency (Mc)	VSWR	Correction (db)
1257.8	1.20	-0.1
1297.8	1.28	-0.1
1348	1.21	-0.1

$$
\begin{aligned}
\text{Corrected Power Output (avg.)} &= 67.2 \text{ dbm} + (-0.1 \text{ db}) \\
&= 67.1 \text{ dbm} \\
\text{Corrected Power Output (peak)} &= 99.1 \text{ dbm} + (-0.1 \text{ db}) \\
&= 99.0 \text{ dbm}
\end{aligned}
$$

The power output from Channel B is recorded on 11 data sheets.

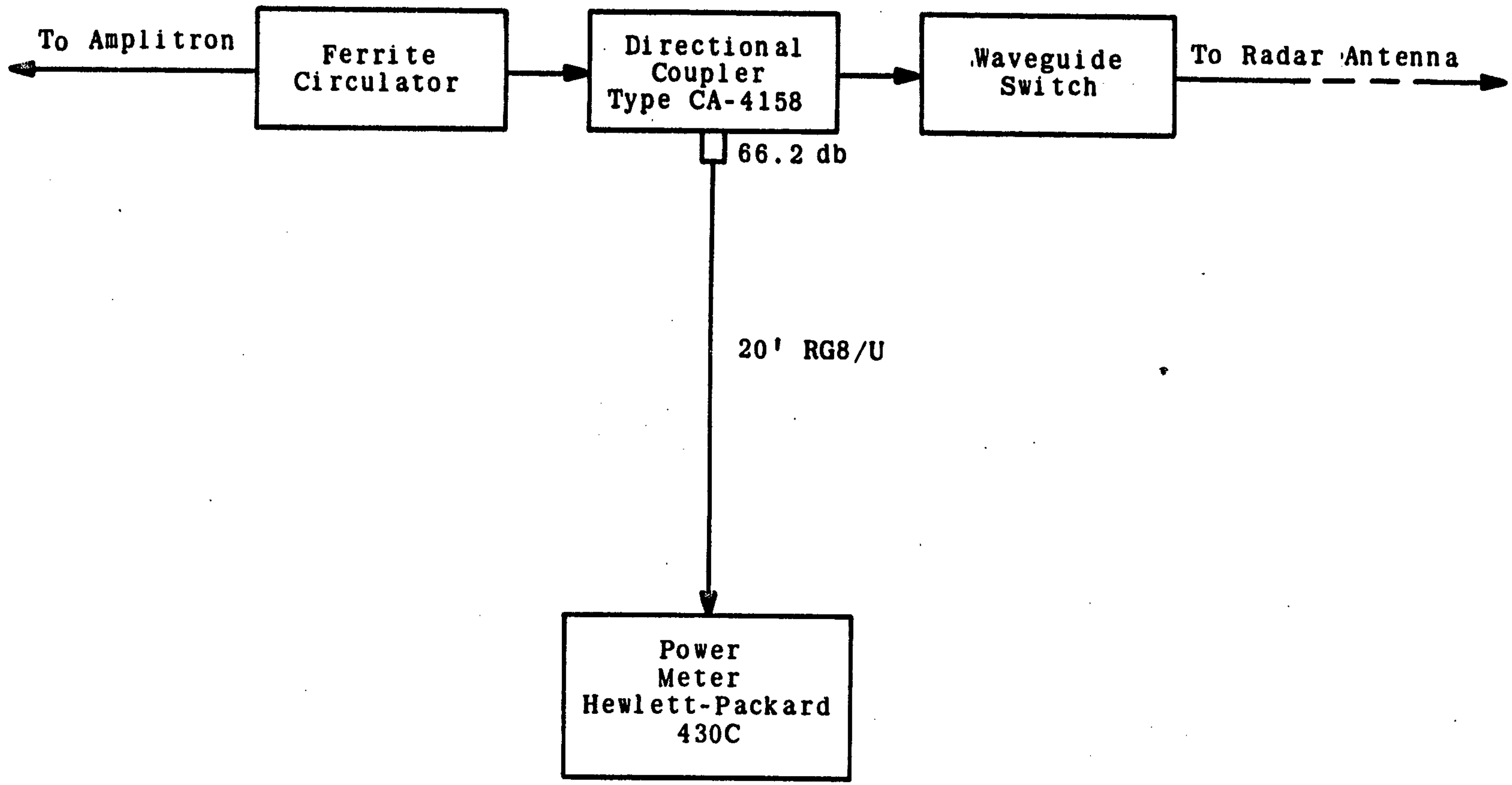


Figure 5.2.2-1. Power Output Test Block Diagram.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/3/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(μs): 1.8 PRF(pps) 360

Significant Control Positions: Linear Polarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading (mw)	Power Meter Reading (dbm)	Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm) Avg.	Power Output (dbm) Peak
1297.2	1832	.77	-1.1	66.2	2.1	67.1	99.0
	1846	.78	-1.1			67.1	99.0
	1900	.76	-1.2			67.0	98.9
	1915	.79	-1.0			67.2	99.1
	1930	.79	-1.0			67.2	99.1
	1945	.78	-1.1			67.1	99.0
	2000	.78	-1.1			67.1	99.0
	2015	.80	-1.0			67.2	99.1
	2030	.80	-1.0			67.2	99.1
	2045	.79	-1.0			67.2	99.1
	2100	.80	-1.0			67.2	99.1
	2115	.80	-1.0			67.2	99.1
	2130	.79	-1.0			67.2	99.1
	2145	.79	-1.0			67.2	99.1
	2200	.79	-1.0			67.2	99.1
	2215	.80	-1.0			67.2	99.1
	2230	.80	-1.0			67.2	99.1

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/6/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(μs): 1.8 PRF(pps) 360

Significant Control Positions: Linear Polarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading (mw)	Power Meter Reading (dbm)	Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm) Avg.	Power Output (dbm) Peak
1295	1115	.720	-1.4	66.2	2.1	66.8	98.7
	1130	.700	-1.6			66.6	98.5
	1145	.720	-1.4			66.8	98.7
	1200	.710	-1.5			66.7	98.6
	1215	.720	-1.4			66.8	98.7
	1230	.720	-1.4			66.8	98.7
	1245	.720	-1.4			66.8	98.7
	1300	.710	-1.5			66.7	98.6
	1315	.710	-1.5			66.7	98.6
	1330	.725	-1.4			66.8	98.7
	1345	.745	-1.3			66.9	98.8
	1400	.720	-1.4			66.8	98.7
	1415	.725	-1.4			66.8	98.7
	1430	.720	-1.4			66.8	98.7
	1437	.720	-1.4			66.8	98.7

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/9/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(μs): 1.8 PRF(pps) 360

Significant Control Positions: CircularPolarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading		Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm)	
		(mw)	(dbm)			Avg.	Peak
1295	0900	.700	-1.6	66.2	2.1	66.6	98.5
	0930	.720	-1.4			66.8	98.7
	1000	.725	-1.4			66.8	98.7
	1030	.724	-1.4			66.8	98.7
	1100	.724	-1.4			66.8	98.7
	1130	.720	-1.4			66.8	98.7
	1200	.740	-1.3			66.9	98.8
	1230	.745	-1.3			66.9	98.8
	1300	.740	-1.3			66.9	98.8
	1330	.740	-1.3			66.9	98.8
	1345	.740	-1.3			66.9	98.8

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/10/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(μs): 1.8 PRF(pps) 360

Significant Control Positions: Linear Polarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading (mw)	Power Meter Reading (dbm)	Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm) Avg.	Power Output (dbm) Peak
1300	1330	.745	-1.3	66.2	2.1	66.9	98.8
	1400	.745	-1.3			66.9	98.8
	1430	.740	-1.3			66.9	98.8
	1500	.700	-1.6			66.6	98.5
	1530	.700	-1.6			66.6	98.5
	1600	.700	-1.6			66.6	98.5
	1630	.710	-1.5			66.7	98.6
	1700	.690	-1.6			66.6	98.5
1297	1730	.700	-1.6			66.6	98.5
	1800	.700	-1.6			66.6	98.5
	1830	.700	-1.6			66.6	98.5
	1900	.710	-1.5			66.7	98.6
	1930	.700	-1.6			66.6	98.5
	2000	.700	-1.6			66.6	98.5
	2030	.700	-1.6			66.6	98.5
	2100						

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/11/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(μs): 1.8 PRF(pps) 360

Significant Control Positions: Linear Polarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading (mw)	Power Meter Reading (dbm)	Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm) Avg.	Power Output (dbm) Peak
1297.8	0900	.720	-1.4	66.2	2.1	66.8	98.7
	0930	.730	-1.4			66.8	98.7
	1000	.710	-1.5			66.7	98.6
	1030	.720	-1.4			66.8	98.7
	1100	.710	-1.5			66.7	98.6
	1130	.710	-1.5			66.7	98.6
	1200	.700	-1.6			66.6	98.5
	1230	.710	-1.5			66.7	98.6
	1300	.700	-1.6			66.6	98.5
	1330	.690	-1.6			66.6	98.5
	1400	.690	-1.6			66.6	98.5
	1430	.700	-1.6			66.6	98.5
	1500						
1243.4	1520	.600	-2.2		1.6	65.5	97.4
1257.8	1545	.600	-2.2			65.5	97.4
	1600	.590	-2.3			65.4	97.3
	1630	.580	-2.4			65.3	97.2
	1700	.580	-2.4			65.3	97.2
	1730	.580	-2.4			65.3	97.2

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/13/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(µs): 1.8 PRF(pps) 360

Significant Control Positions: Linear Polarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading (mw)	Power Meter Reading (dbm)	Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm) Avg.	Power Output (dbm) Peak
1257.8	1530	.600	-2.2	66.2	1.6	65.5	97.4
	1600	.590	-2.3			65.4	97.3
	1630	.580	-2.4			65.3	97.2
	1700	.590	-2.3			65.4	97.3
	1730	.580	-2.4			65.3	97.2
	1800						
	1830						
	1900						
	1930						
	2000						
	2030						
	2100						
	2130						
	2200						
	2230						
	2300						

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/14/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(μs): 1.8 PRF(pps) 360

Significant Control Positions: Linear Polarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading (mw)	Power Meter Reading (dbm)	Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm) Avg.	Power Output (dbm) Peak
1257.5	1430	---		66.2	1.6		
	1545	.580	-2.4			65.3	97.2
	1600					65.3	
	1630						
	1700						
	1730						
	1800						
	1830						
	1900						
	1930						
1347	2015	.660	-1.8		2.1	66.4	98.3
1300	2120	.720	-1.4		2.1	66.8	98.7

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: APSR-1B-A Site Code: 5110.11 Date: 12-15/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(μs): 1.8 PRF(pps) 360

Significant Control Positions: Linear Polarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading (mw)	Power Meter Reading (dbm)	Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm) Avg.	Power Output (dbm) Peak
1347	1220	.680	-1.7	66.2	2.1	66.5	98.4
	1240	.640	-1.9			66.3	98.2
	1300	.670	-1.7			66.5	98.4
	1330	.650	-1.9			66.3	98.2
	1410	.660	-1.8			66.4	98.3
	1430	.640	-1.9			66.3	98.2
	1500						
	1530						
	1600						
	1630						
	1700						
	1730						
	1800	.660	-1.8			66.4	98.3
	1830						
	1900						
	1915						

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/16/62

Xmtr. Serial No.: 52 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(μs): 1.8 PRF(pps) 360

Significant Control Positions: Linear Polarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading (mw)	Power Meter Reading (dbm)	Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm) Avg.	Power Output (dbm) Peak
1347	0830	.650	-1.9	66.2	2.1	66.3	98.2
↓	0900	.620	-2.1	↓	↓	66.1	98.0
	0930	.610	-2.2			66.0	97.9

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/17/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(μs): 1.8 PRF(pps) 360

Significant Control Positions: Linear Polarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading (mw)	Power Meter Reading (dbm)	Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm) Avg.	Power Output (dbm) Peak
1298	0930	---		66.2	2.1		
1298	1230	---					
1298	1600	---					
1297.8	1850	.720	-1.4			66.8	98.7
	1900						98.7
	1930						98.7
	2000						98.7
	2030						98.7
	2100	.710	-1.5			66.7	98.6
	2130	.720	-1.4			66.8	98.7
	2200	.710	-1.5			66.7	98.6
	2230	.720	-1.4			66.8	98.7
1296.7	2300	.720	-1.4			66.8	98.7

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/19/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350

Modulation: Pulse PW(μs): 1.8 PRF(pps) 360

Significant Control Positions: Linear Polarization, Transmitter B

Measuring Devices: HP-430C, 20' RG-8/U

Frequency (Mc)	Time of Day	Power Meter Reading (mw)	Power Meter Reading (dbm)	Coupling Factor (db)	Atten. Inserted (db)	Power Output (dbm) Avg.	Power Output (dbm) Peak
1296.9	0900	.740	-1.3	66.2	2.1	66.9	98.8
	0930					66.9	98.8
	1000					66.9	98.8
	1030					66.9	98.8
	1100					66.9	98.8
	1130	.760	-1.2			67.0	98.9
	1200	.720	-1.4			66.8	98.7
	1230	.720	-1.4			66.8	98.7
	1350	.700	-1.6			66.6	98.5
	1400	.720	-1.4			66.8	98.7
	1435	.720	-1.4			66.8	98.7
	1450	.750	-1.3			66.9	98.8
	1500	.750	-1.3			66.9	98.8
	1530						
	1600	.720	-1.4			66.8	98.7
	1630	.740	-1.3			66.9	98.8
	1700	.730	-1.4			66.8	98.7
	1730	.740	-1.3			66.9	98.8

Measurement Instructions

Measure power output at standard test frequencies of each tuning band. Output for AM and FM transmitters is AO or FO. This sheet is not applicable for SSB transmitters. Coupling factor is the sum of the coupling factors of all the directional couplers used.

Use reverse side for block diagram and remarks.

5.2.3 Spurious Emission

Since the ARSR is designed to operate into only one antenna, open-field spurious emission measurements were made at the test site for the standard test frequencies of 1257.8 Mc, 1297.8 Mc and 1348 Mc. The radar antenna may have linear (horizontal) or circular polarization. Linear polarization is normally used except during periods of inclement weather. Therefore, nearly all spurious emission measurements were made with the radar antenna horizontally polarized. Spurious emission measurements were made on December 9, 1962, with the radar antenna circularily polarized and the test antenna horizontally polarized. This was made at the mean standard test frequency of 1297.8 Mc for comparison with the radar horizontally polarized. Measurements were made on the following day with the radar horizontally polarized at the 1297.8 Mc frequency. Measurements were made for both horizontal and vertical polarizations of the test antennas. The test antennas were rotated in the azimuth and moved in elevation for maximum received signal. The test antennas were mounted on a pole at the rear of the measurement van at a height of approximately 28 feet. Figure 2-7 is a photograph of the test site with the measurement van in position. The ground elevation at the test site is 1482 feet. This placed the test antenna at an elevation of 1510 feet which is 70 feet lower in elevation than the radar antenna at an elevation of 1580 feet. In normal operation, the radar antenna is elevated 2° 30'. For all the spectrum signature tests, the radar antenna was depressed to -17'.

Prior to the start of the spectrum signature measurements, the radar antenna brake was burned out and was not replaced until most of the measurements were completed. As a consequence, the radar antenna could not be jogged into the precise bearing for maximum received signal at the test site. In order to obtain the precise bearing of the test site from the radar site, a pulsed signal at the same PRF and pulse width of the radar signal was transmitted from the test site. At the radar site, the transmitter was turned off and the received signal displayed on an oscilloscope external to the radar receiver. Syncing the signal with the internal sync of the oscilloscope resulted in a steady display of the received signal. The antenna was then rotated by hand for maximum received signal. The bearing for maximum received signal was found to be 69° 45' on the azimuth ring of the radar antenna. For all the far-field measurements except the special pulse count test, the antenna was depressed to -17' in elevation, rotated by hand to the 69° 45' point on the azimuth ring and secured by rope at this bearing.

Absolute measurements of spurious emissions by the signal substitution method were made at selected points through the third harmonic of the ARSR radar. The objective of this task was to take spurious emissions through the second harmonic of the radar frequency. These measurements were to be continued into the higher frequencies if time permitted after the antenna patterns and pulse count tests. Measurements were actually made through the second band of the Stoddart NM-62A which included the third harmonic of the radar fundamental frequencies.

Spurious emission measurements were first made on the lower standard test frequency of 1257.8 Mc on December 11, 1962. When measurements on this frequency were resumed on December 13th, the spectrum appeared to have changed. As a consequence, the measurements made on the 11th were repeated on December 13, 1962. The data taken on December 11th are left in the report for comparison.

Automatic spurious emission scans were recorded from 1.0 kMc to 4.4 kMc on all three standard test frequencies and from 4.4 kMc to 10.0 kMc on the mean standard test frequency of 1297.8 Mc.

The FIM (field intensity meter) receivers were checked for spurious responses prior to commencing spurious emission tests. High-level signals (from -10 dbm to +13 dbm) at the standard test frequencies were fed into the FIM receivers and the receivers scanned throughout the frequency range of 14 kc to 10 kMc for receiver spurious responses. A low-pass filter was placed in the signal generator output to prevent any harmonic of the generator from being mistaken for a receiver spurious response. Figure 5.2.3-2 is a recording of an automatic scan for spurious responses of the Stoddart NM-62A in the frequency range of 1.0 kMc to 2.3 kMc. Spurious emission scans were taken with the test antennas properly oriented but with the radar turned off. Typical spurious emission scans of the environment are shown in recorded form in Figures 5.2.3-3 through 5.2.3-6.

Figure 5.2.3-1 is the block diagram of the setup for the measurement of spurious emission. The signal is carried to the receivers in the measurement van be a length of 100' RG-260/U and 12' RG-8/U from the test antennas. On strong signals, an attenuator was required in the antenna lead. High-pass fundamental frequency rejection filters were placed in the lead before the receiver input during the search for spurious emissions. The signal strength is measured at the receiver input by the signal substitution method. Measurements were made with the receiver in the Direct Peak position. In the signal substitution method, the test receiver bandwidth was set to 5 Mc.

Signal power available (P_A) at the test antenna terminals is the sum of the signal generator output plus the net cable losses plus any attenuation inserted before the receiver to attenuate the radar signal. Net cable losses are the difference between the losses in the test cable and the losses in the calibrating cable from the signal generator. In equation form, the power available at the test antenna terminals is

$$P_{A(dbm)} = \text{Signal generator output (dbm)} + \text{net cable losses(db)} + \text{attenuation inserted (db)}$$

The power density (P_D) at the test antenna is then

$$P_{D(dbm/m^3)} = P_A/A$$

where

A = effective area of test antenna in square meters
$= \lambda^2 G/4\pi$

G = power gain of test antenna over an isotropic antenna = 1.64 for tuned dipole

λ = wavelength of received spurious signal = $300/f_{mc}$ meters

f_{mc} = frequency in megacycles

therefore

$$P_{D(dbm/m^2)} = 10 \log P_{A/A} = 10 \log P_A/\lambda^2 G/4\pi$$

$$= 10 \log P_A + 10 \log \frac{4\pi}{300^2} + 20 \log f_{mc} - 10 \log G$$

$$= 10 \log P_A - 38.6 + 20 \log f_{mc} - 10 \log G$$

As an example, the power density at the test antenna will be computed for the mean standard test frequency of 1297.8 Mc with the radar antenna circularily polarized and the test antenna horizontally polarized. The data are recorded on the first line of the first data sheet dated December 9, 1962.

$$10 \log P_A = \text{Signal generator (dbm)} + \text{cable loss (db)} + \text{attenuation inserted (db)}$$

$$= -22.1 \text{ dbm} + 5.2 \text{ db} + 40 \text{ db} = 23.1 \text{ dbm}$$

$$10 \log G = 10.2 \text{ db}$$

$$20 \log f_{mc} = 20 \log 1297.8 = 62.2 \text{ db}$$

$$P_{D(dbm/m^2)} = 10 \log P_A - 38.6 + 20 \log f_{mc} - 10 \log G$$

$$= 23.1 \text{ dbm} - 38.6 \text{ db} + 62.2 \text{ db} - 10.2 \text{ db}$$

$$= 36.5 \text{ dbm/m}^2$$

As a check on the measured values of power density at the test antenna, computation will be made for the theoretical values expected at the test antenna at the three standard test frequencies of 1297.8 Mc, 1257.8 Mc, and 1343 Mc with both the radar and test antennas horizontally polarized. Measurements were made on December 10th, 13th, and 15th, 1962. The power density at one meter from an isotropic radar radiator is the radar power output (P_T) divided by 4π. Power density is then

$P_D = P_T/4\pi$. However, the radar antenna has a stated gain G of 34.3 db over an isotropic antenna in the radar frequency range. The power density at the radar antenna is now

$$P_D = P_T G/4\pi$$

Since the field intensity varies inversely as the distance, the power density at the test antenna terminals is

$$P_D = P_T G/4\pi d^2$$

where d is the separation between the radar and test antenna in meters = 21,562 ft./3.28 ft./meter = 6560 meters

Computations will be made for the expected power density at the standard test frequency of 1297.8 Mc which was measured on December 10, 1962.

$$P_D = 10 \log P_T + 10 \log G - 10 \log 4\pi - 20 \log d$$

$10 \log P_T$ = 98.8 dbm from power output of 12/10/62

$10 \log G$ = 34.3 dbm

$10 \log 4\pi$ = 11.0 db

$20 \log d = 20 \log 6560 = 76.4$ db

$$P_{D(dbm/m^2)} = 10 \log P_T + 10 \log G - 10 \log 4\pi - 20 \log d$$

$$= 98.8 \text{ dbm} + 34.3 \text{ db} - 11 \text{ db} - 76.4 \text{ db}$$

$$= 45.7 \text{ dbm}$$

The measured value was 39.8 dbm. Theoretical and measured values of power density for the three standard test frequencies are tabulated below.

Frequency (Mc)	Date Measured	P_T (dbm)	P_D Measured (dbm/m^2)	P_D Theoretical (dbm/m^2)
1297.7	12/10/62	98.8	39.8	45.7
1258.7	12/13/62	97.2	42.4	44.1
1348.2	12/15/62	98.3	38.4	45.2

No attempt will be made to relate the differences to cancellation of the direct wave by a ground-reflected wave. It can be seen from Figures 2-5 and 2-6 that any theoretical values of reflection coefficient would not apply due to the roughness of the terrain. The roughness of this terrain is such that only diffuse reflection will occur. The actual power into the antenna may have been less than P_T. Additional losses would have occurred in the waveguide and rotary joint after the directional coupler where the transmitted power was measured. The measured data are recorded on nine (9) data sheets.

Since this radar had such a broad spurious emission spectrum, signal substitution measurements were limited to a selected number of frequencies. However, it was felt that this limited number of measurements could not give a complete picture of the spurious emission spectrum. In lieu of these measurements recordings of automatic spurious emission scans were made above 1.0 kMc. These spurious emission scans are shown in Figures 5.2.3-7 through 5.2.3-43. If it is desired, the levels in db above 1 μv, can be easily converted to power in dbm. One μv into a 50-ohm receiver input is equal to -107 dbm. The level of the signal above 1 μv must be added to this figure. This level is the sum of the signal amplitude on the ordinate and receiver attenuator setting. In an automatic scan, the receiver can be calibrated at one frequency only. Therefore, a gain correction must be made for all other frequencies in the scan. The receiver was calibrated for the standard test frequency.

As an example, the level in dbm will be obtained for the signal in Figure 5.2.3-7.

1 μv	= -107 dbm
Ordinate Level	= 31 db above 1 μv
Receiver Attenuator	= 100 db
Gain Correction	= 0 db

$$\text{Signal level (dbm)} = -107 \text{ dbm} + 31 \text{ db} + 100 \text{ db} + 0 \text{ db}$$
$$= 24 \text{ dbm}$$

The level at the receiver measured in the signal substitution test on December 13, 1962, was

$$\text{Signal level (dbm)} = \text{Sig. generator (dbm)} + \text{attenuation inserted}$$
$$= -16.1 \text{ dbm} + 40.1 \text{ db}$$
$$= 24 \text{ dbm}$$

More than one scan was made around high-level signals in order to see the lower level spurious emissions. The lower level spurious emissions were observed by removing receiver attenuation. In some instances as many as five scans were made. Tabulated below are the number of scans made in each frequency range for each polarization of the test antenna.

Std. Test Frequency (Mc)	Frequency Range (kMc)	No. of Scans	Polarization	Figure Numbers
1257.8	1.0 - 2.3	4	Hor.	5.2.3-7 to 11
	1.0 - 2.3	4	Vert.	5.2.3-11 to 15
	2.3 - 4.4	2	Hor.	5.2.3-15 to 17
	2.3 - 4.4	2	Vert.	5.2.3-17 to 19
1297.8	1.0 - 2.3	4	Hor.	5.2.3-19 to 23
	1.0 - 2.3	3	Vert.	5.2.3-23 to 26
	2.3 - 4.4	1	Hor.	5.2.3-26
	2.3 - 4.4	1	Vert.	5.2.3-27
	4.4 - 7.3	1	Hor.	5.2.3-28
	4.4 - 7.3	1	Vert.	5.2.3-29
	7.3 - 10.0	1	Hor.	5.2.3-30
1348	1.0 - 2.3	5	Hor.	5.2.3-31 to 36
	1.0 - 2.3	4	Vert.	5.2.3-36 to 40
	2.3 - 4.4	2	Hor.	5.2.3-40 to 42
	2.3 - 4.4	2	Vert.	5.2.3-42 to 44

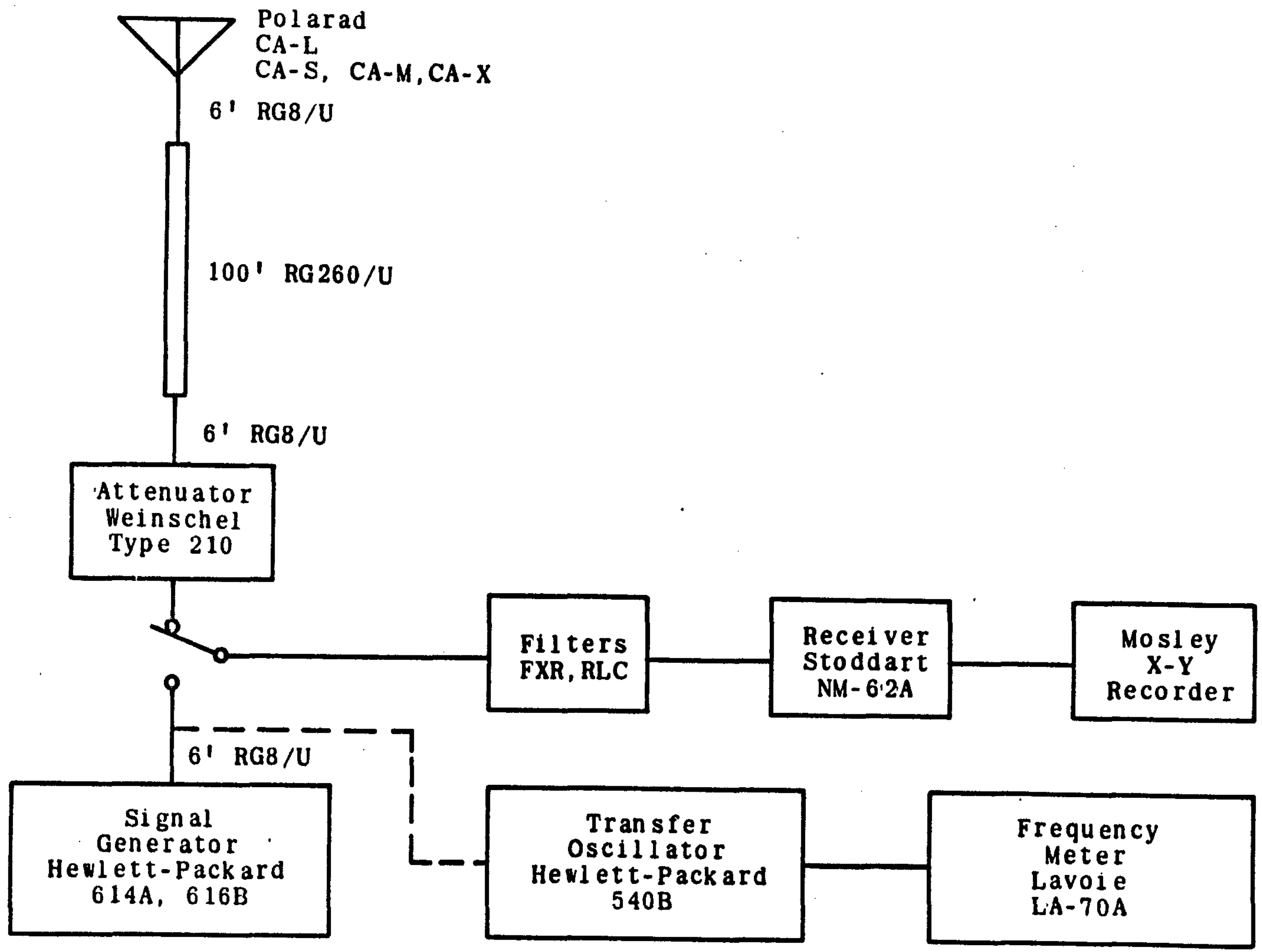


Figure 5.2.3-1. Spurious Emission Test Block Diagram.

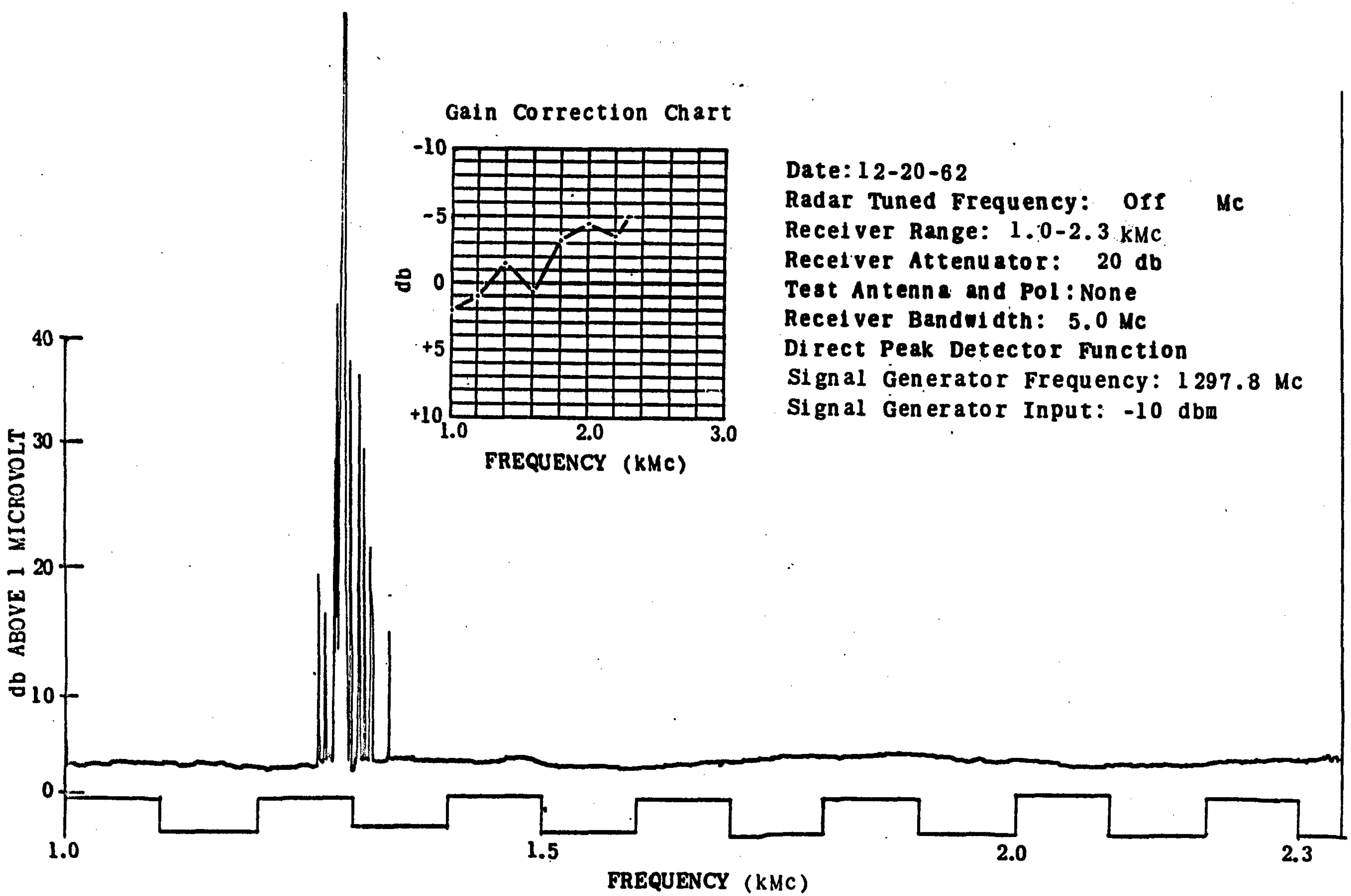


Figure 5.2.3-2. Spurious Response of Stoddart NM-62A.

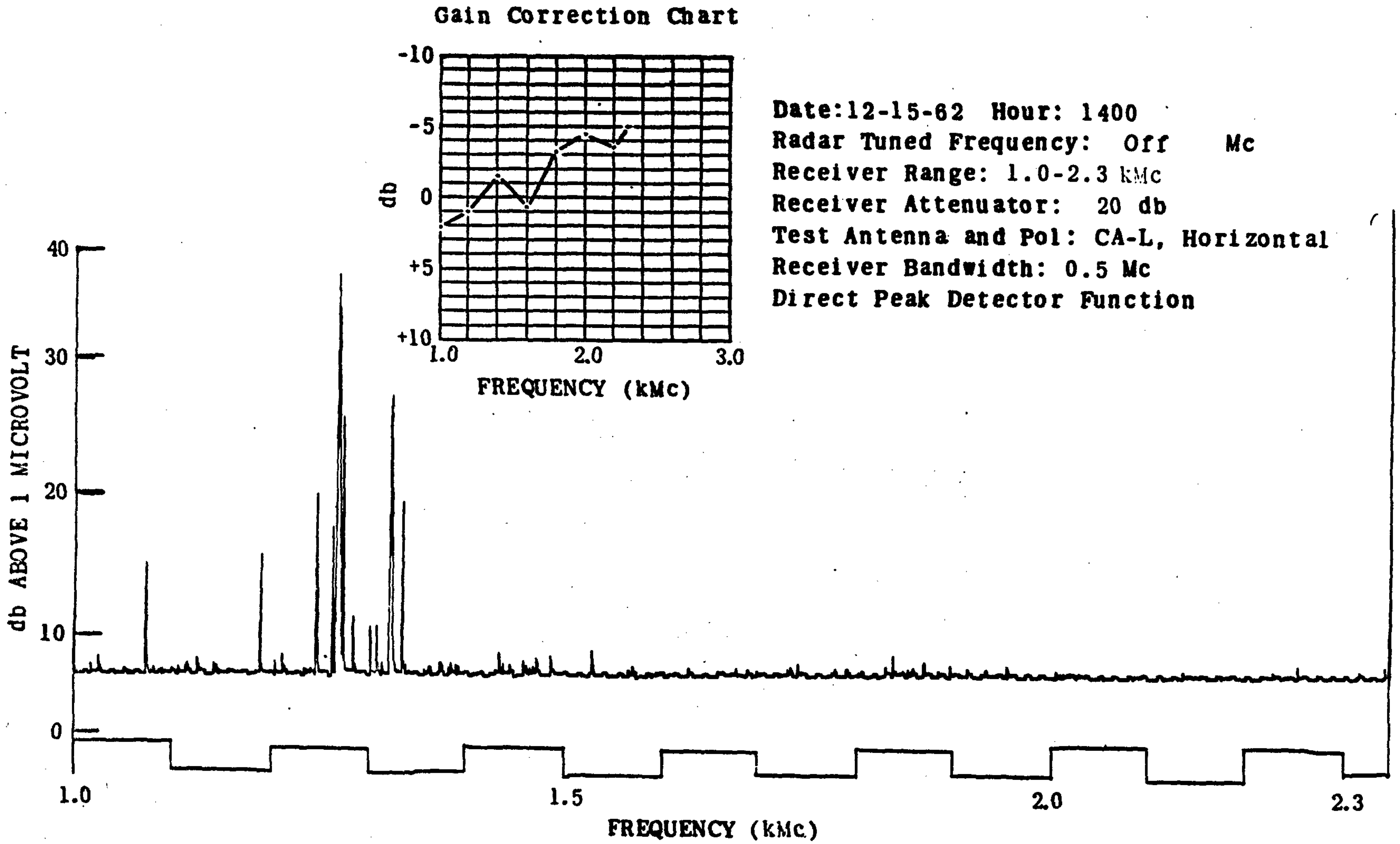


Figure 5.2.3-3. Spurious Emission Scan of Environment - Radar Off.

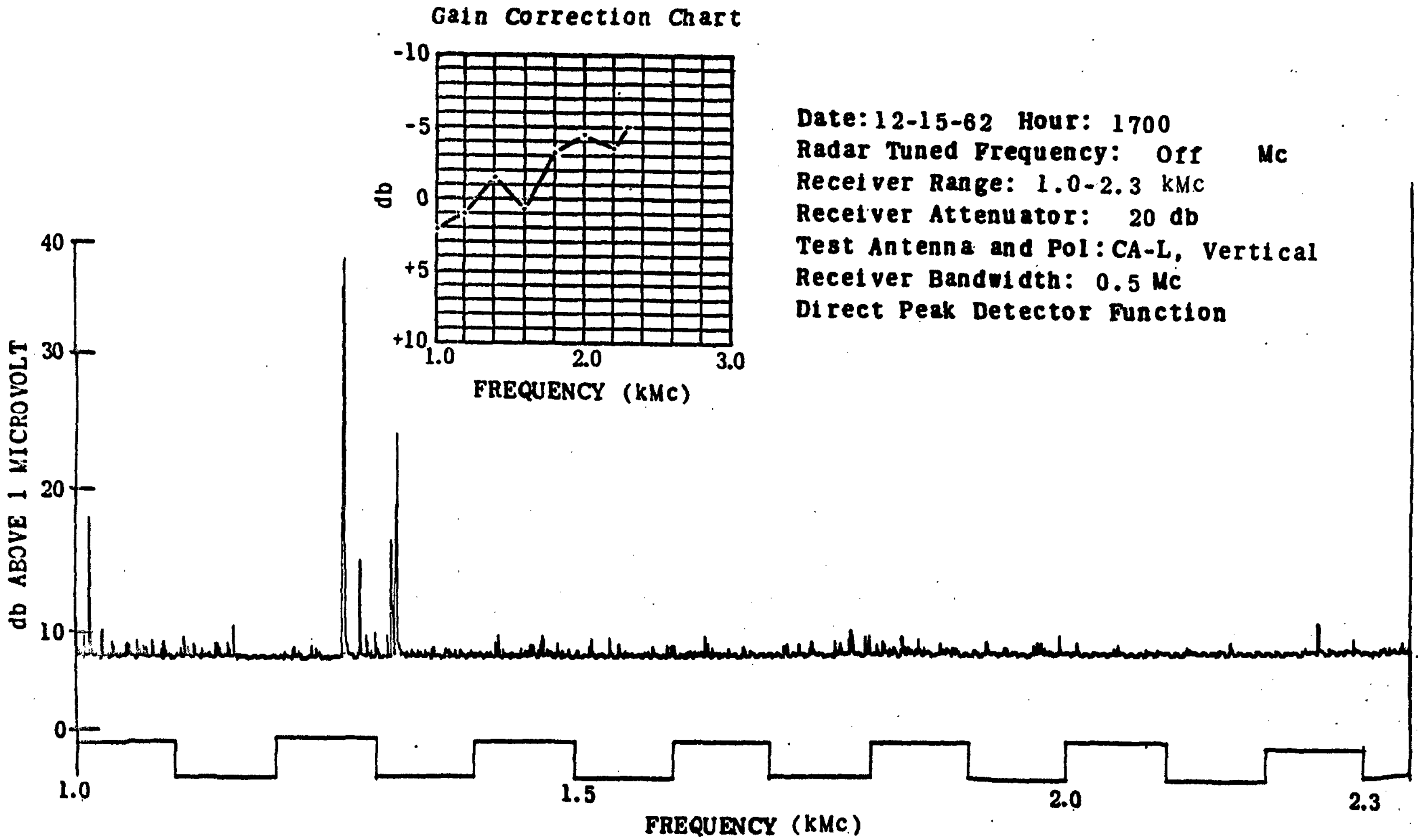


Figure 5.2.3-4. Spurious Emission Scan of Environment - Radar Off.

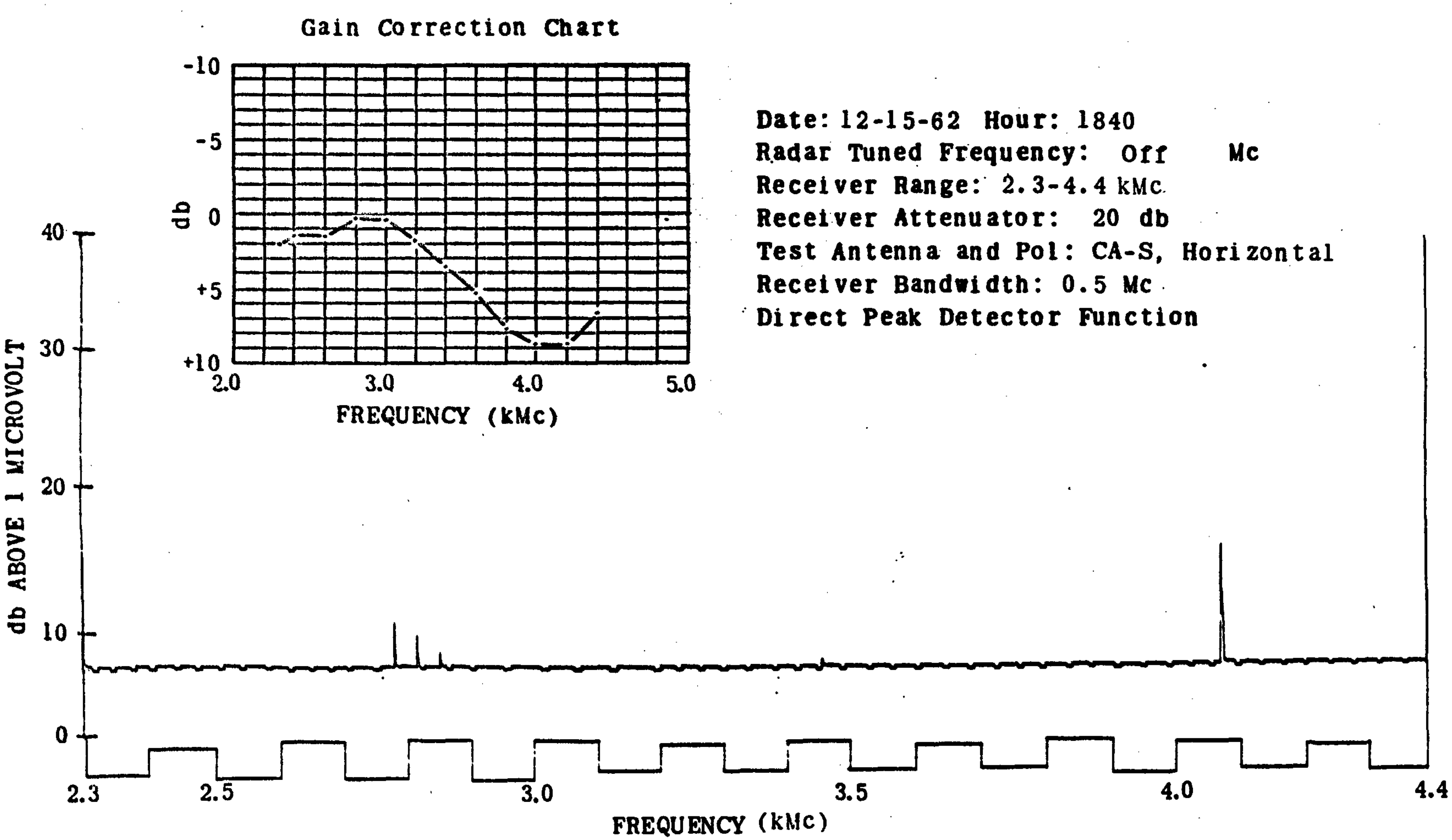


Figure 5.2.3-5. Spurious Emission Scan of Environment - Radar Off.

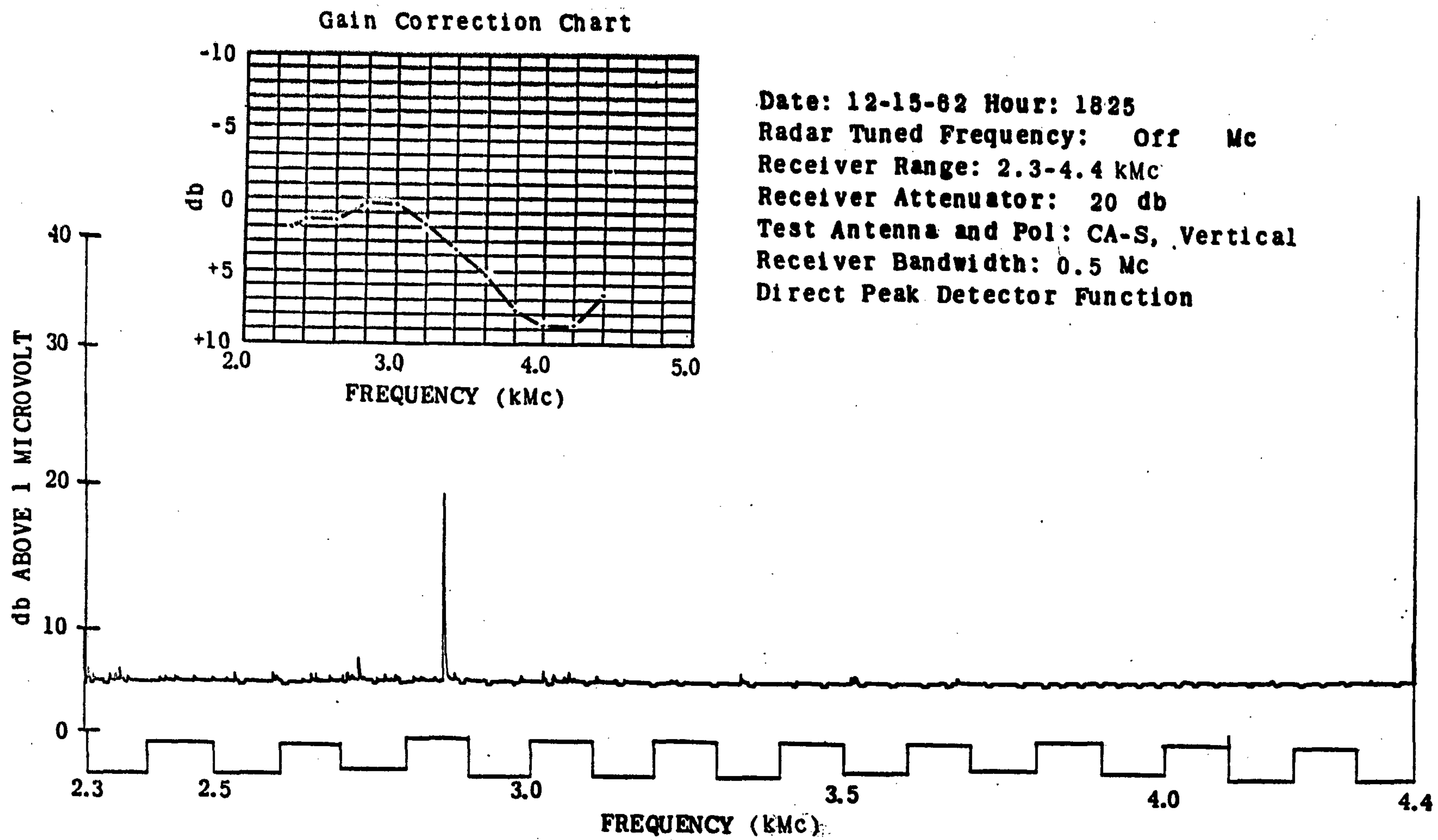


Figure 5.2.3-6. Spurious Emission Scan of Environment - Radar Off.

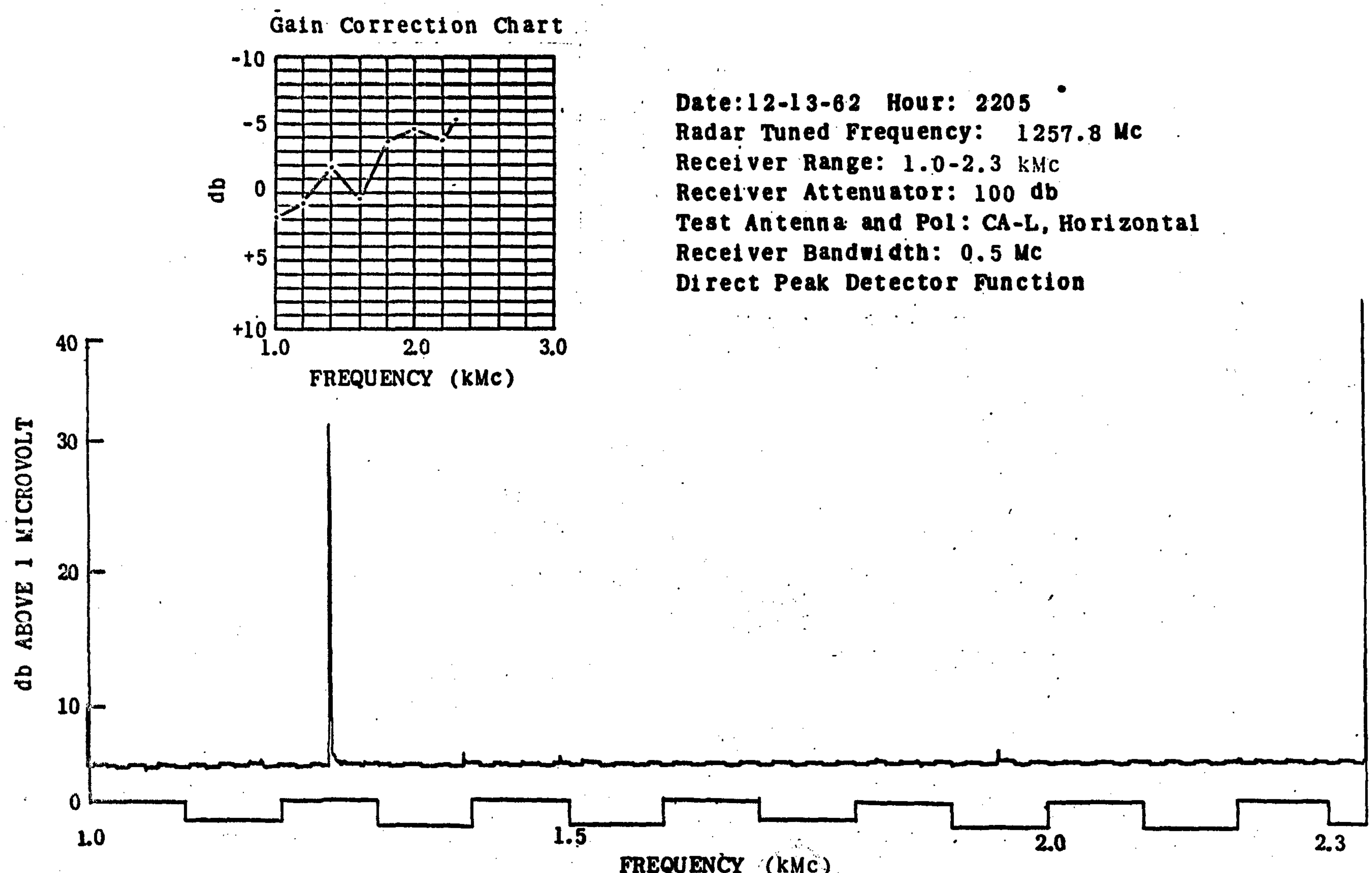


Figure 5.2.3-7. Spurious Emission Scan (f_o = 1257.8 Mc) - H, 100 db.

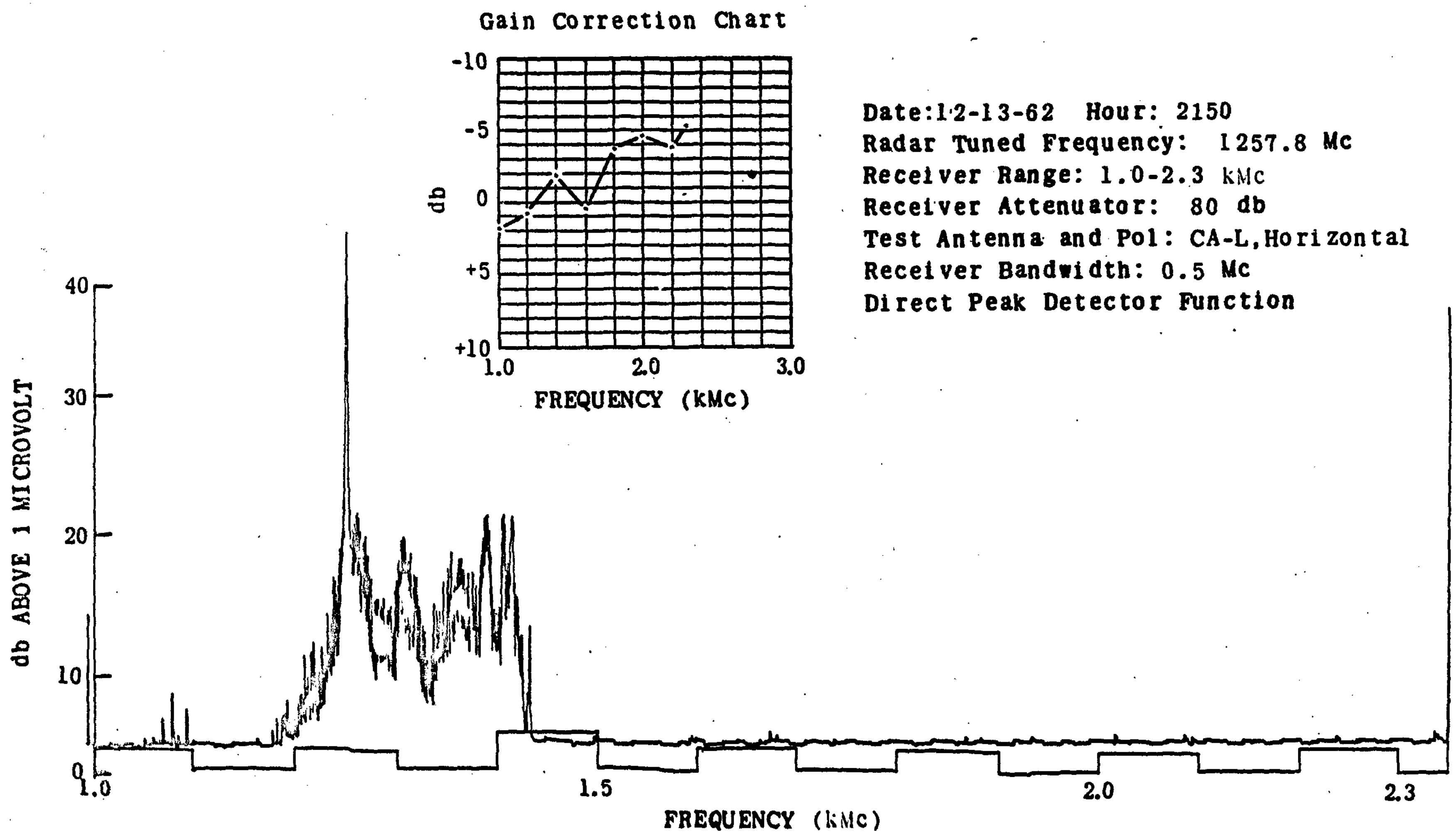


Figure 5.2.3-8. Spurious Emission Scan (f_o = 1257.8 Mc) - H, 80 db.

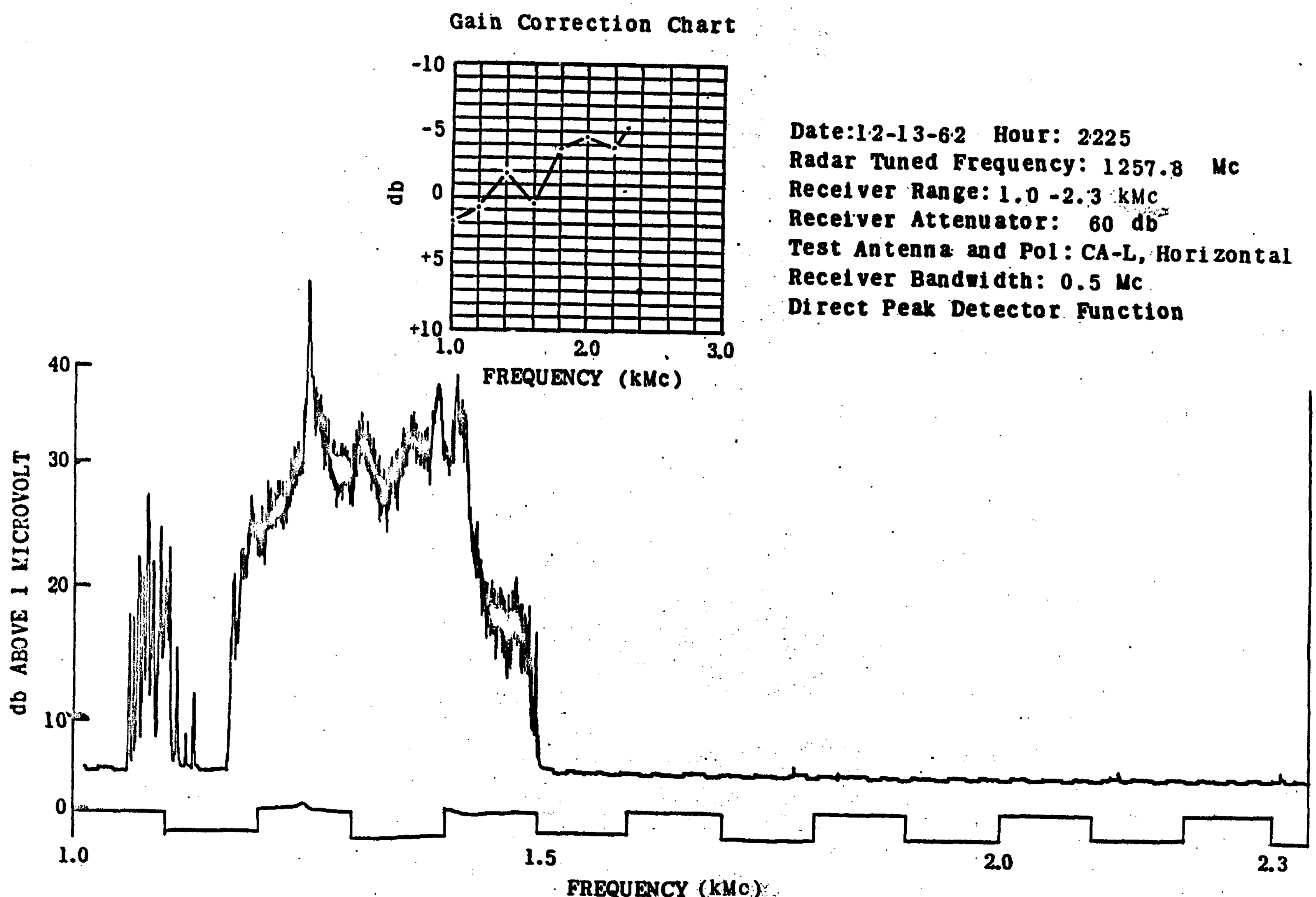


Figure 5.2.3-9. Spurious Emission Scan (f_o = 1257.8 Mc) - H, 60 db.

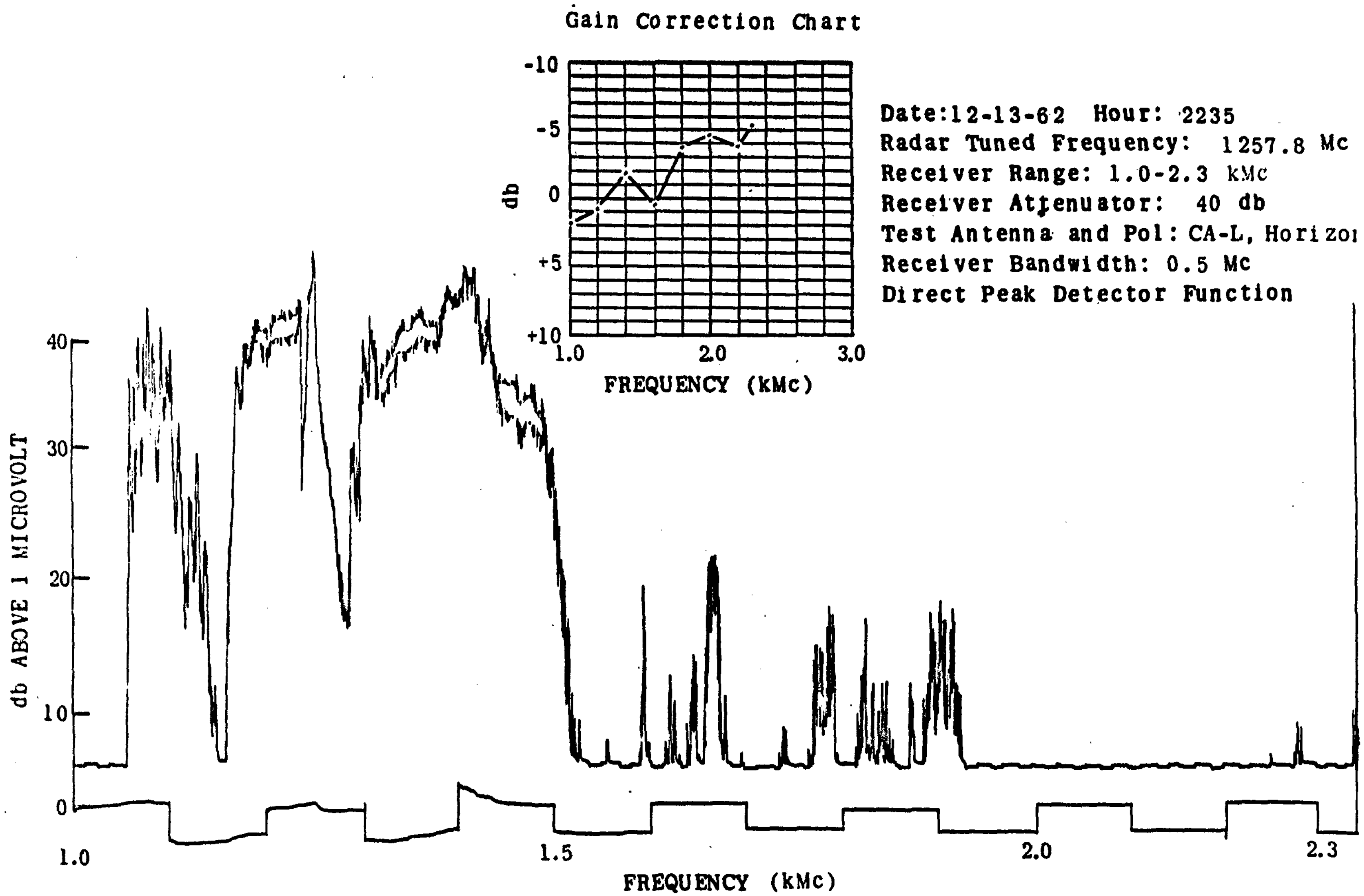


Figure 5.2.3-10. Spurious Emission Scan (f_o = 1257.8 Mc) - H, 40 db.

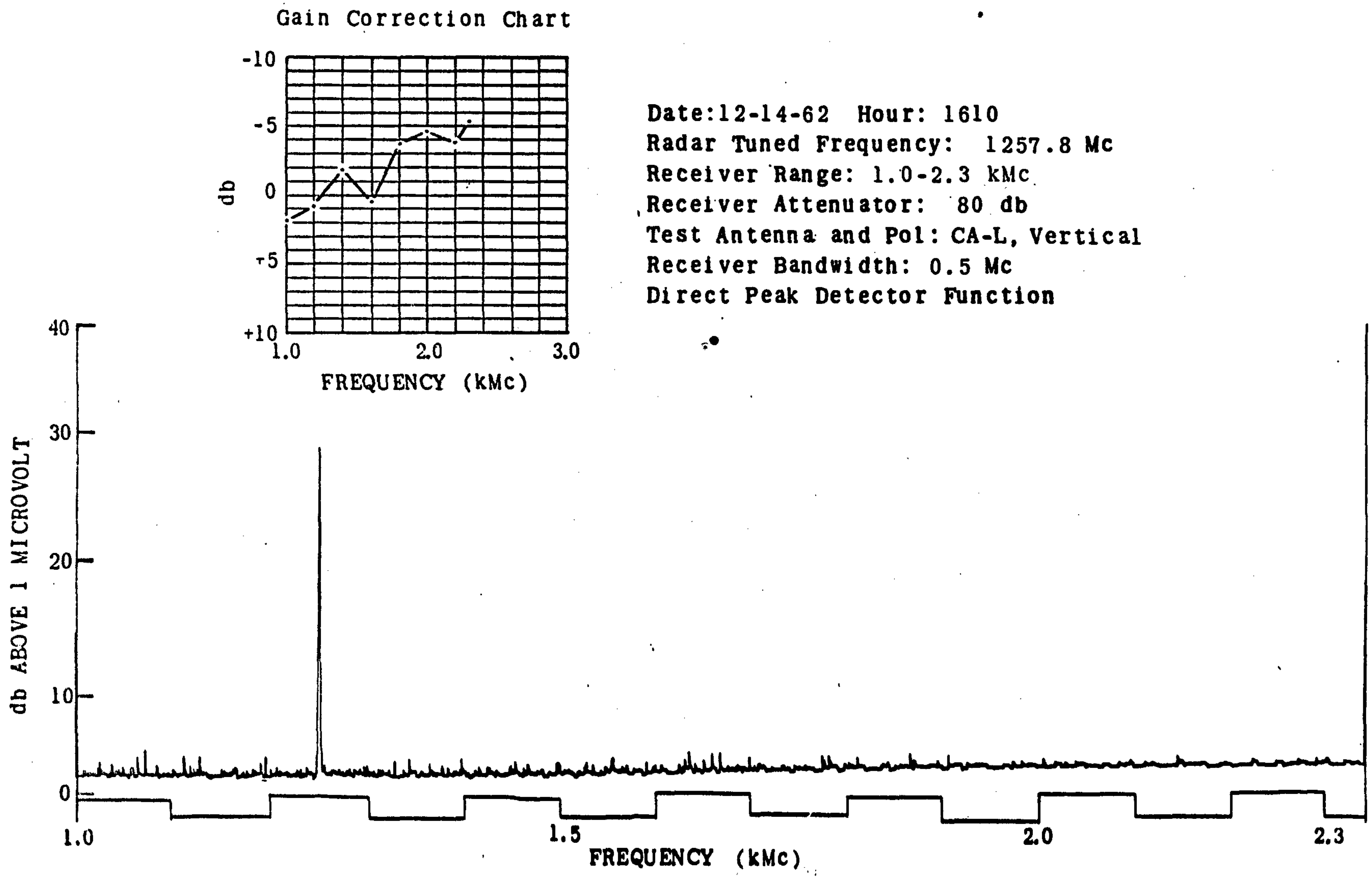


Figure 5.2.3-11. Spurious Emission Scan (f_o = 1257.8 Mc) - V, 80 db.

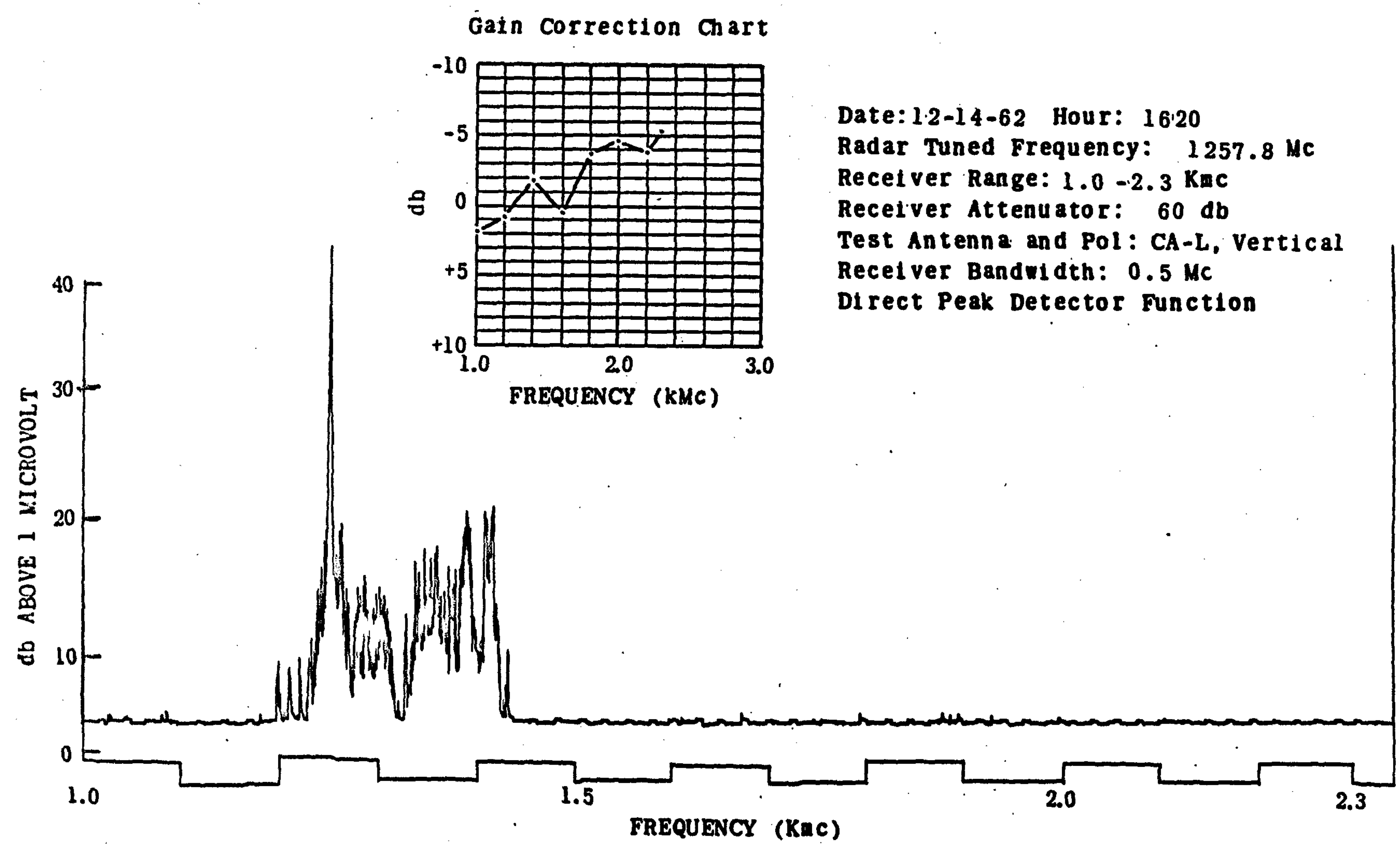


Figure 5.2.3-12. Spurious Emission Scan (f_o = 1257.8 Mc) - V, 60. db.

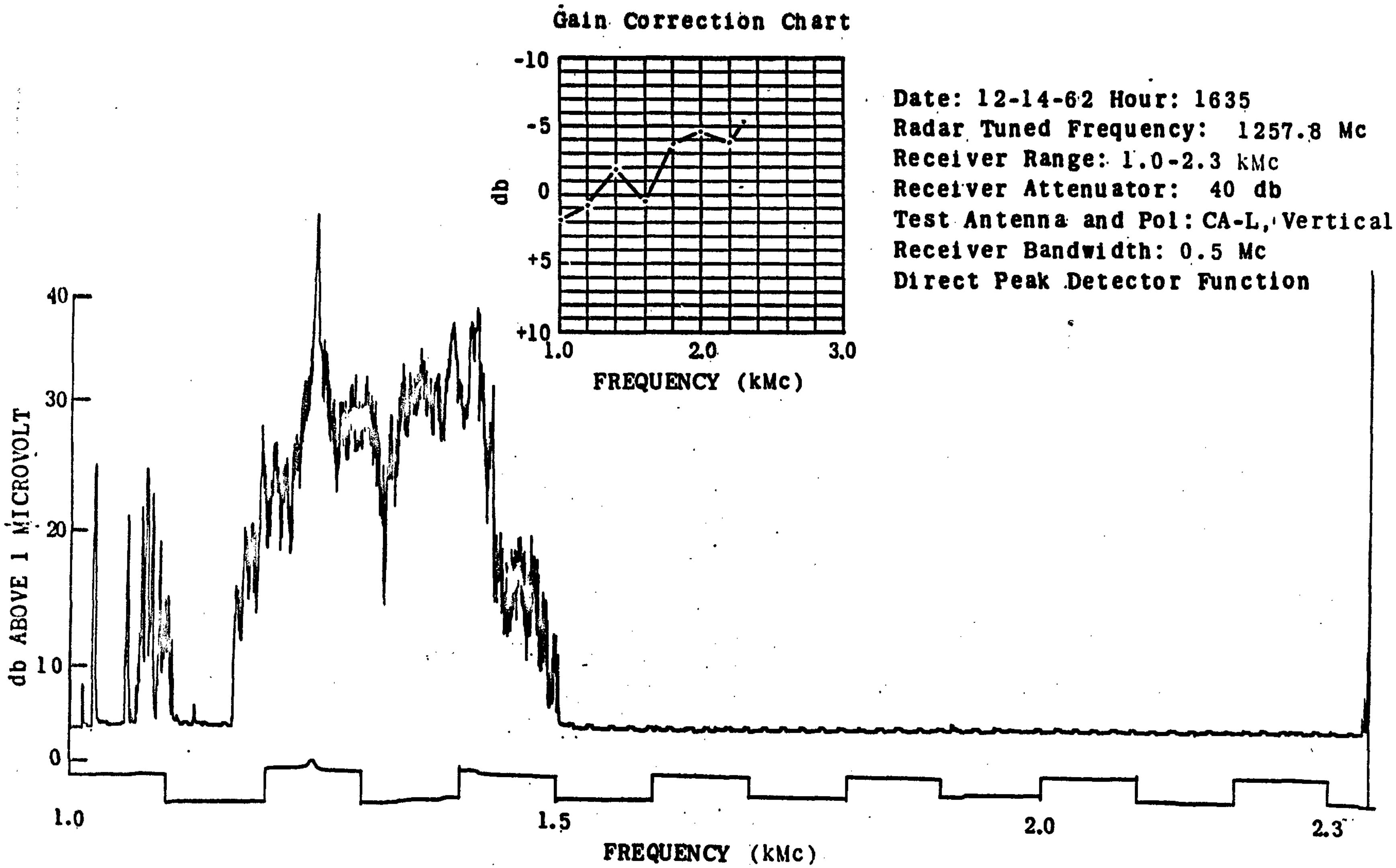


Figure 5.2.3-13. Spurious Emission Scan (f_o = 1257.8 Mc) - V, 40. db.

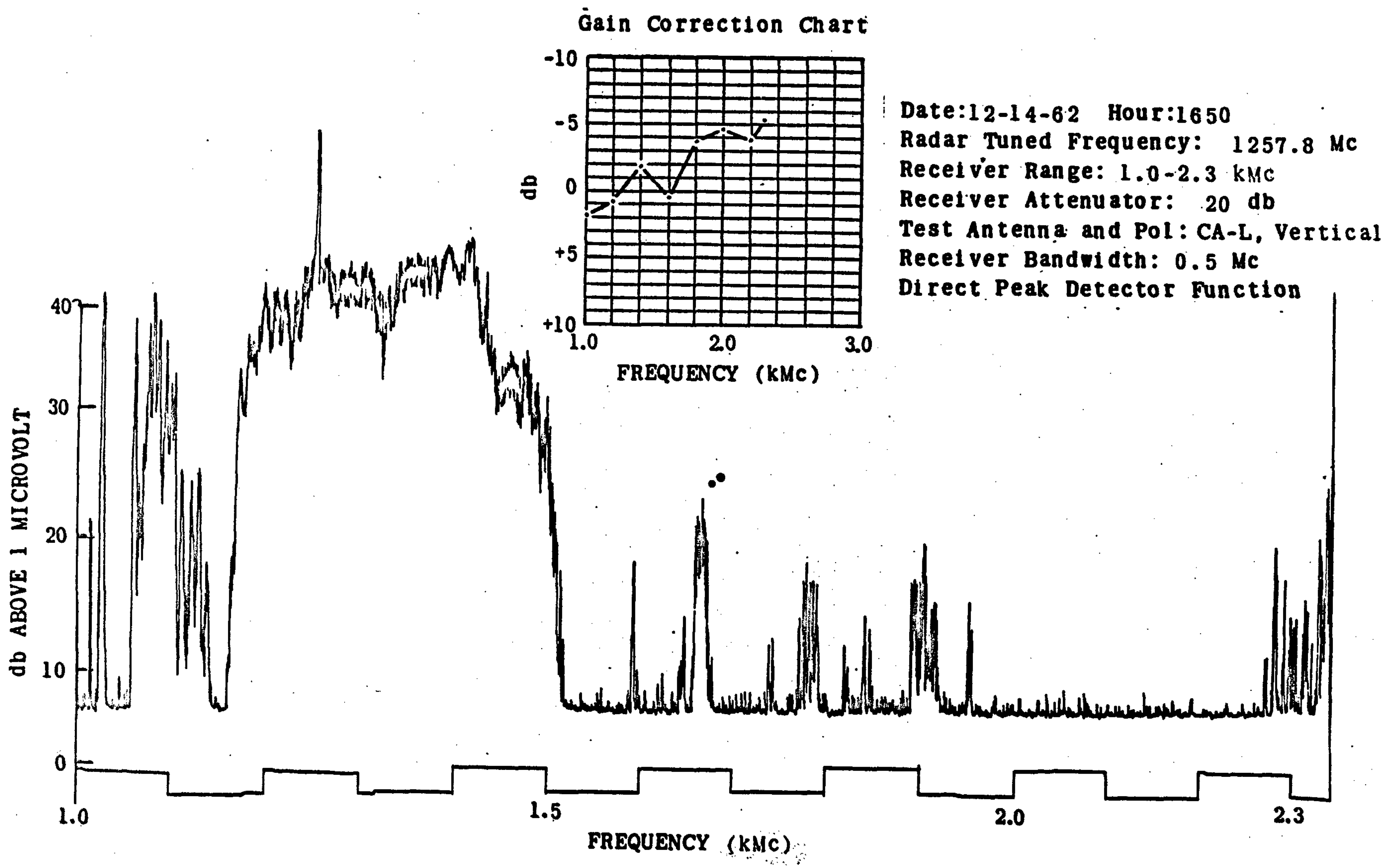


Figure 5.2.3-14. Spurious Emission Scan (f_o = 1257.8 Mc) - V, 20 db.

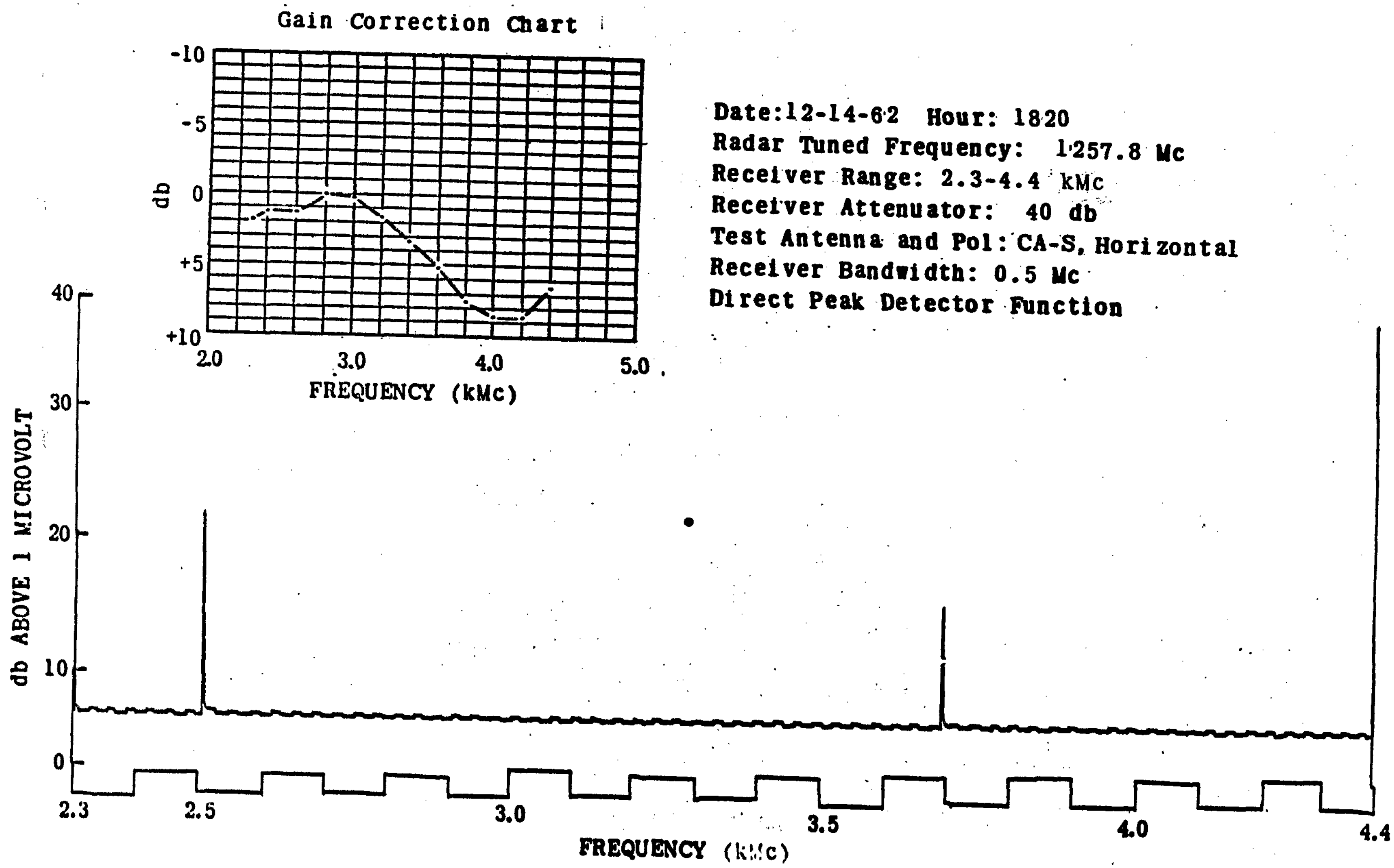


Figure 5.2.3-15. Spurious Emission Scan (f_o = 1257.8 Mc) - H, 40 db.

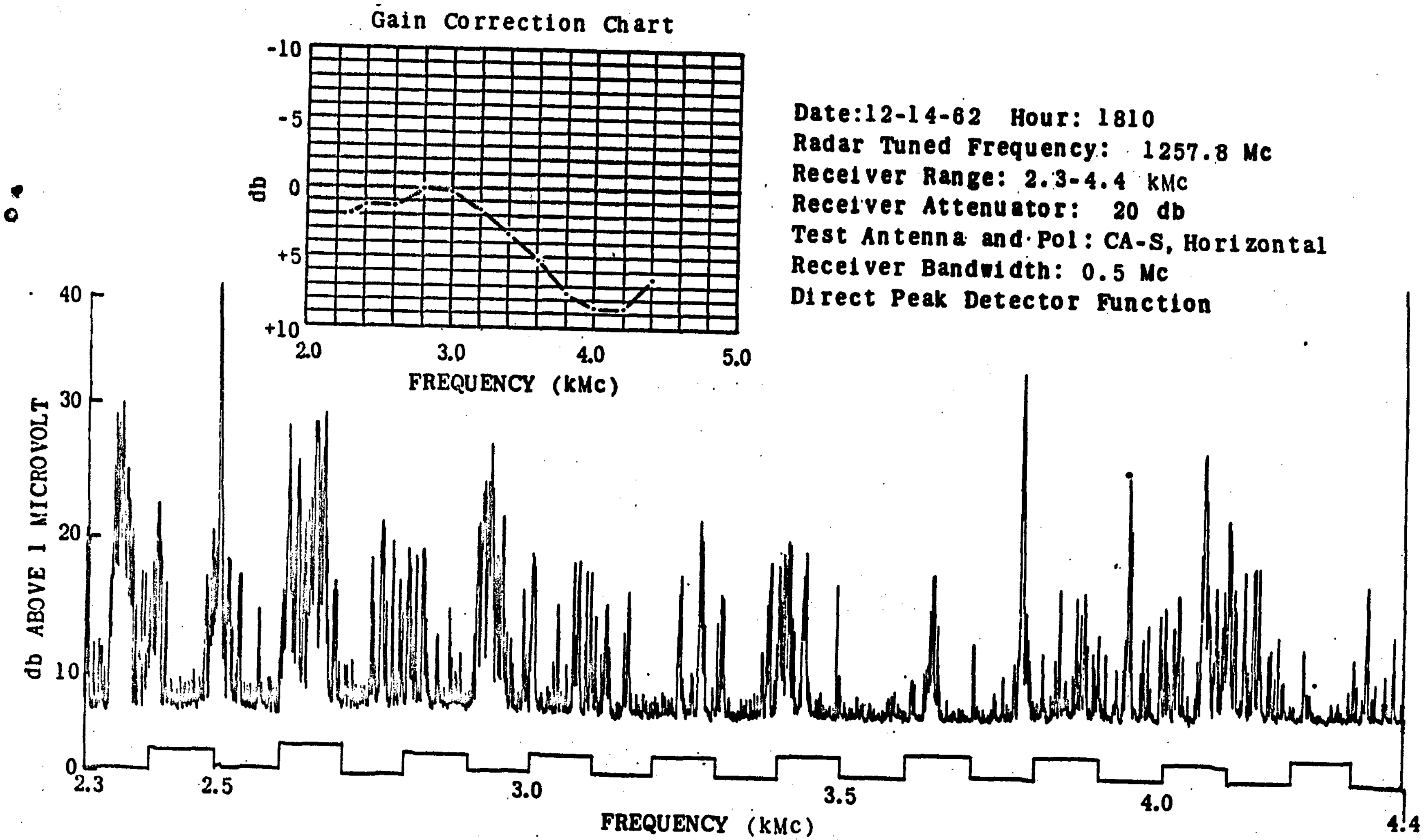


Figure 5.2.3-16. Spurious Emission Scan (f_o = 1257.8 Mc) - H, 20 db.

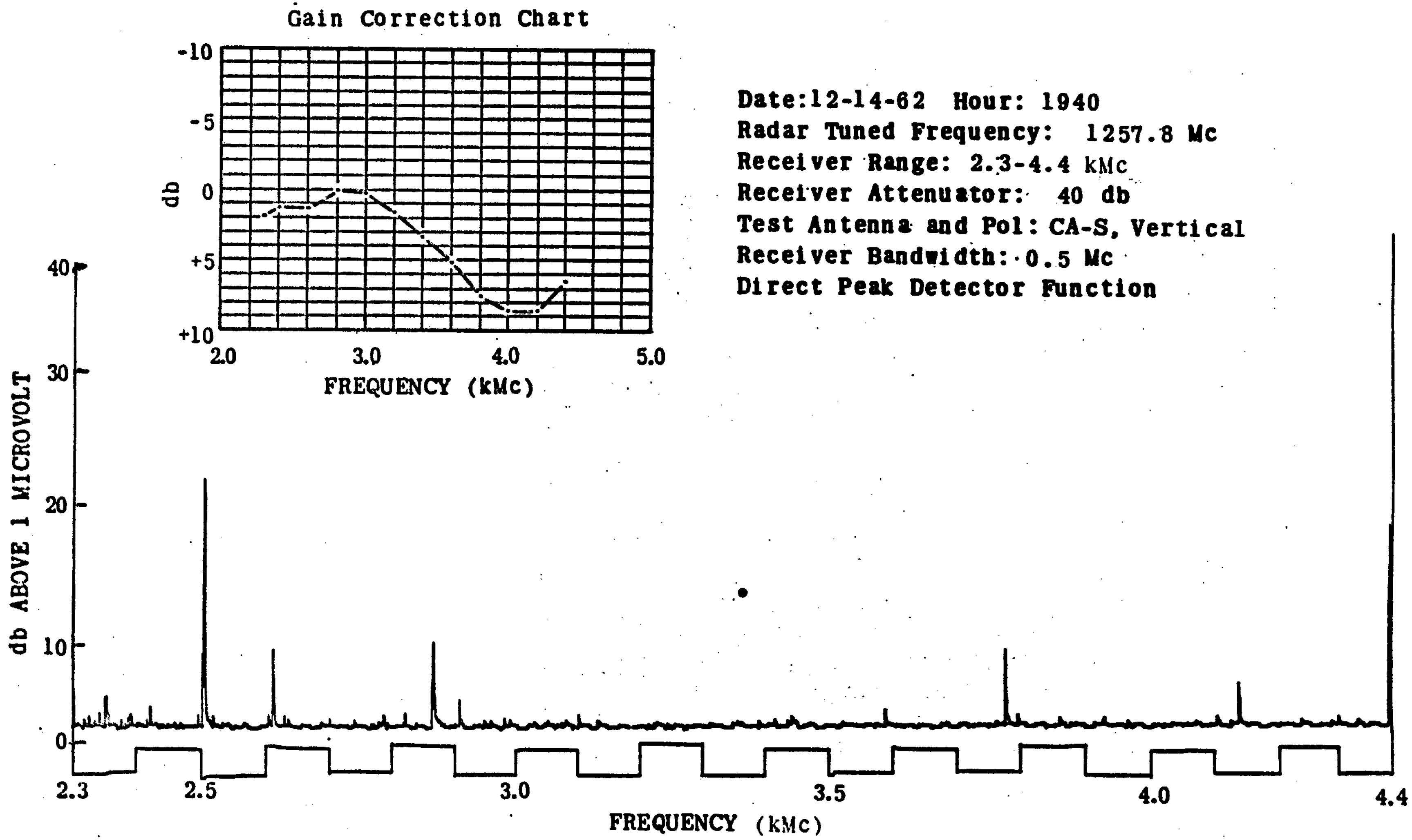


Figure 5.2.3-17. Spurious Emission Scan (f_o = 1257.8 Mc) - V, 40 db.

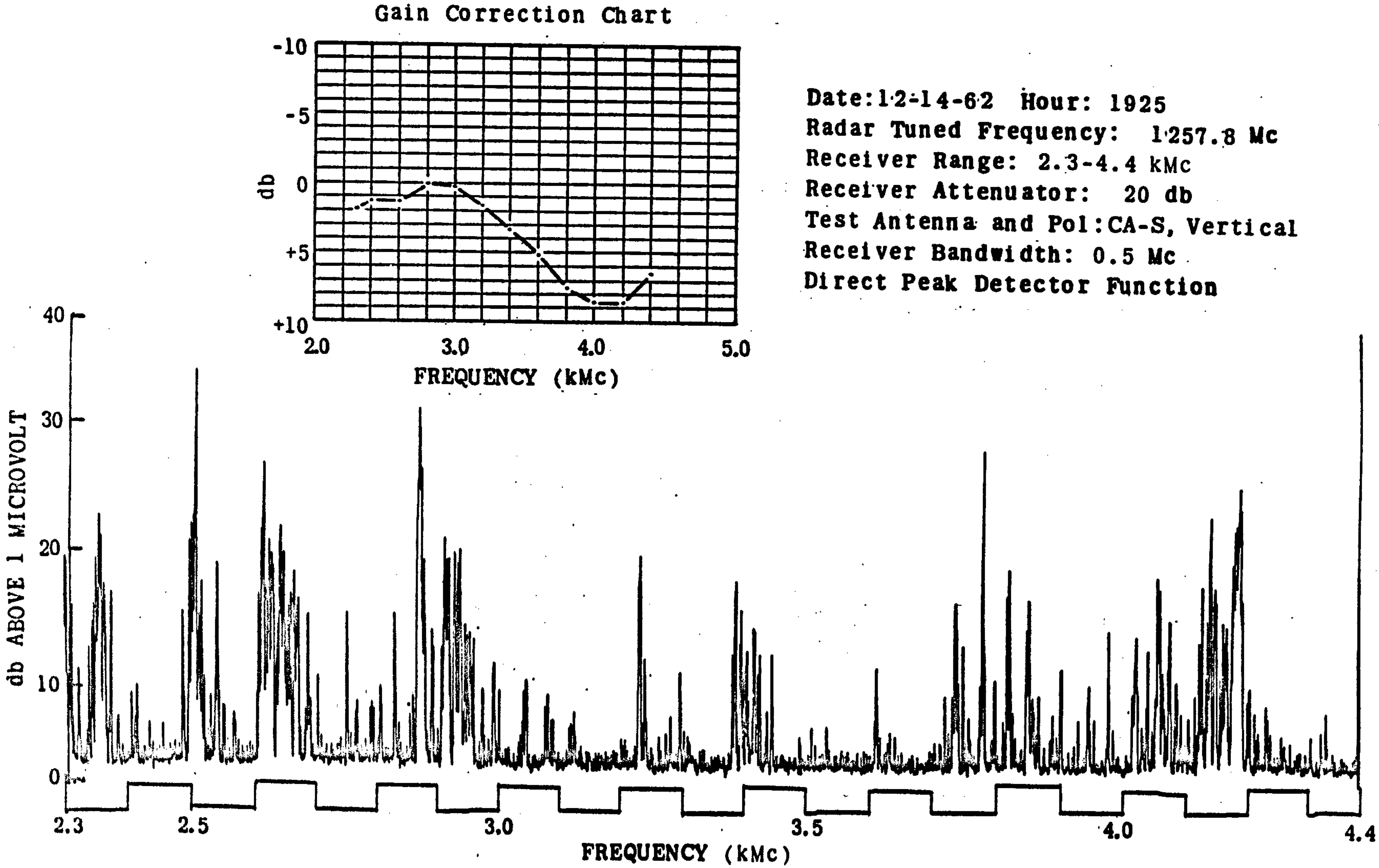


Figure 5.2.3-18. Spurious Emission Scan (f_o = 1257.8 Mc) - V, 20 db.

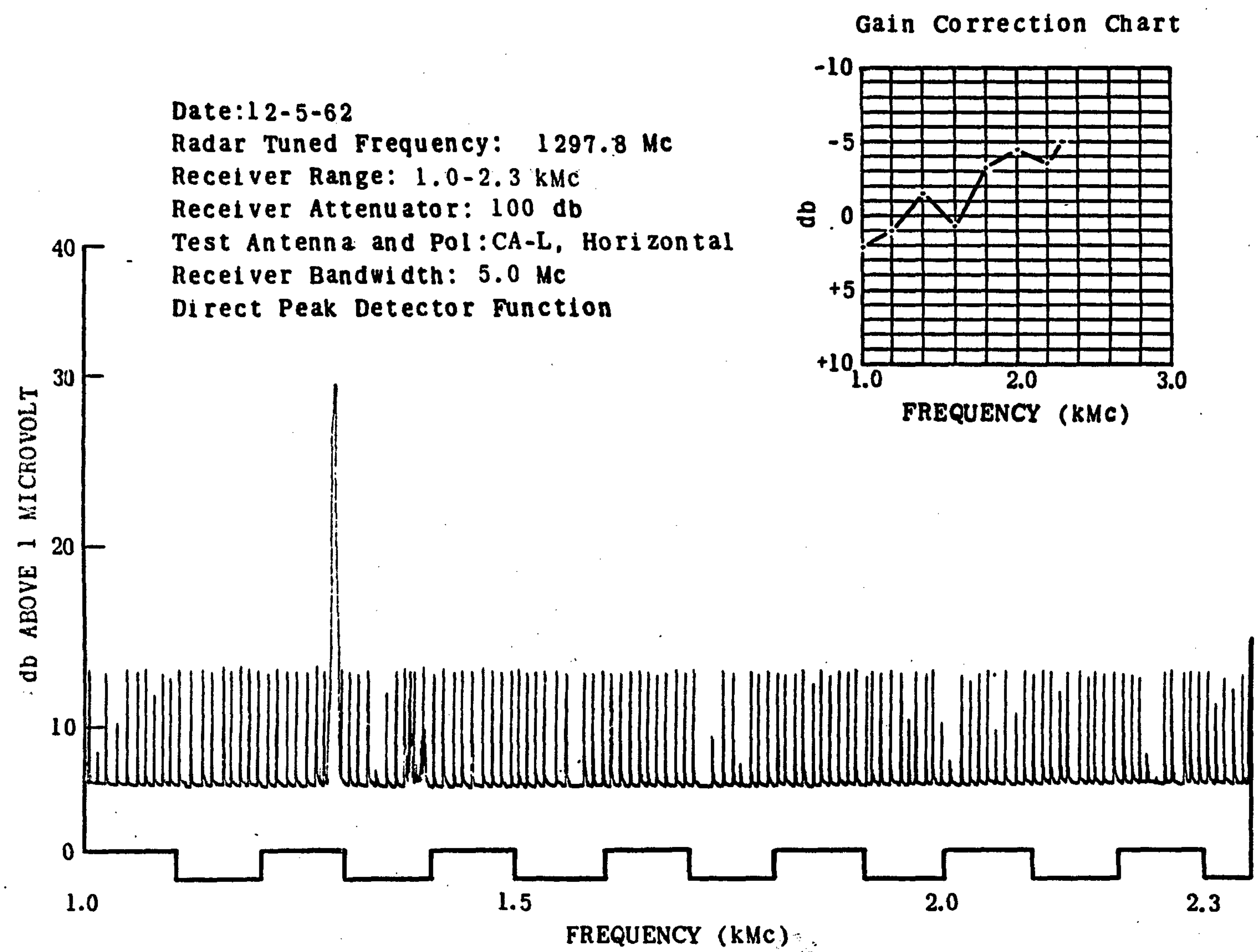


Figure 5.2.3-19. Spurious Emission Scan (f_o = 1297.8 Mc) - H, 100 db.

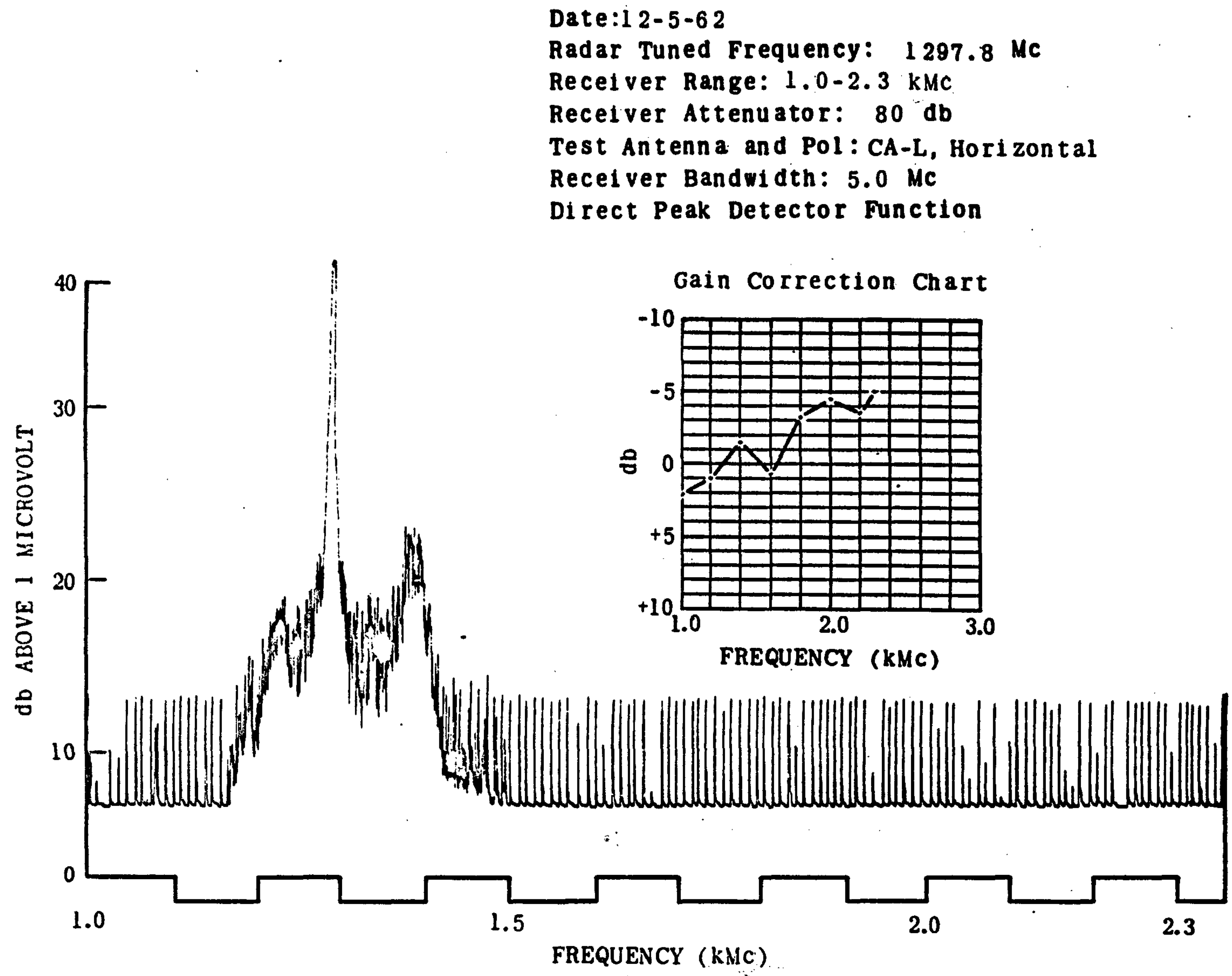


Figure 5.2.3-20. Spurious Emission Scan (f_o = 1297.8 Mc) - H, 80 db.

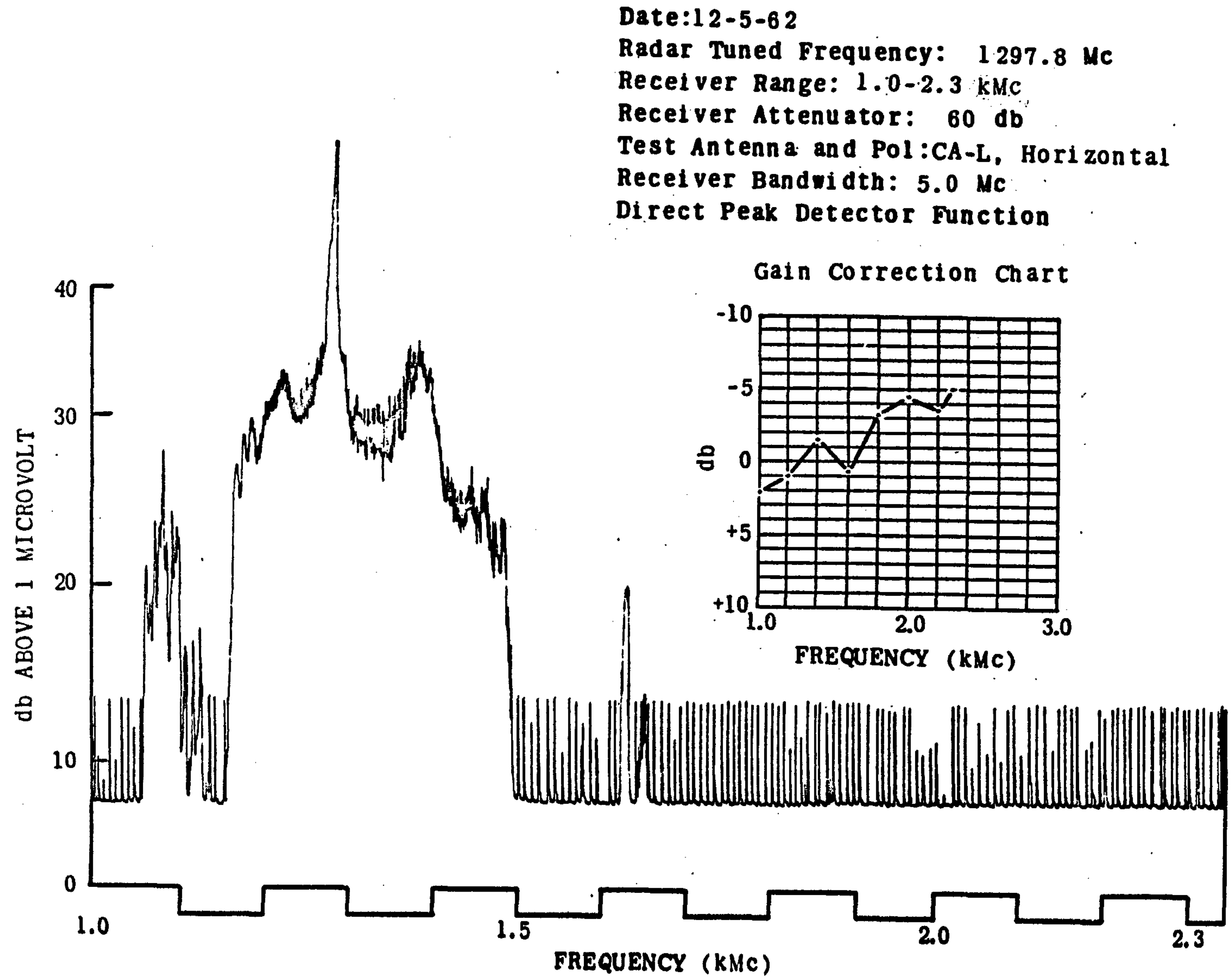


Figure 5.2.3-21. Spurious Emission Scan (f_o = 1297.8 Mc) - H, 60 db.

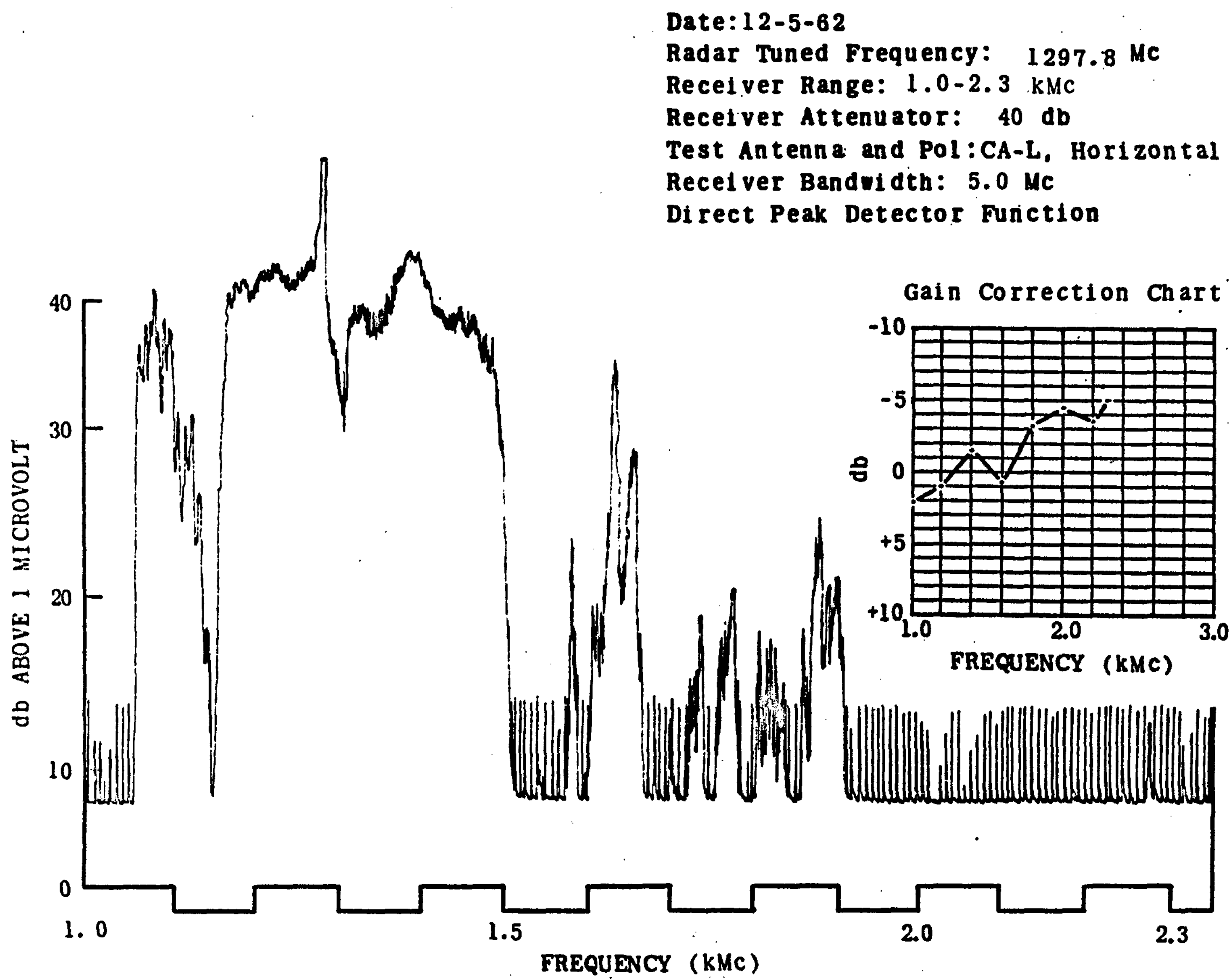


Figure 5.2.3-22. Spurious Emission Scan (f_o = 1297.8 Mc) - H, 40 db.

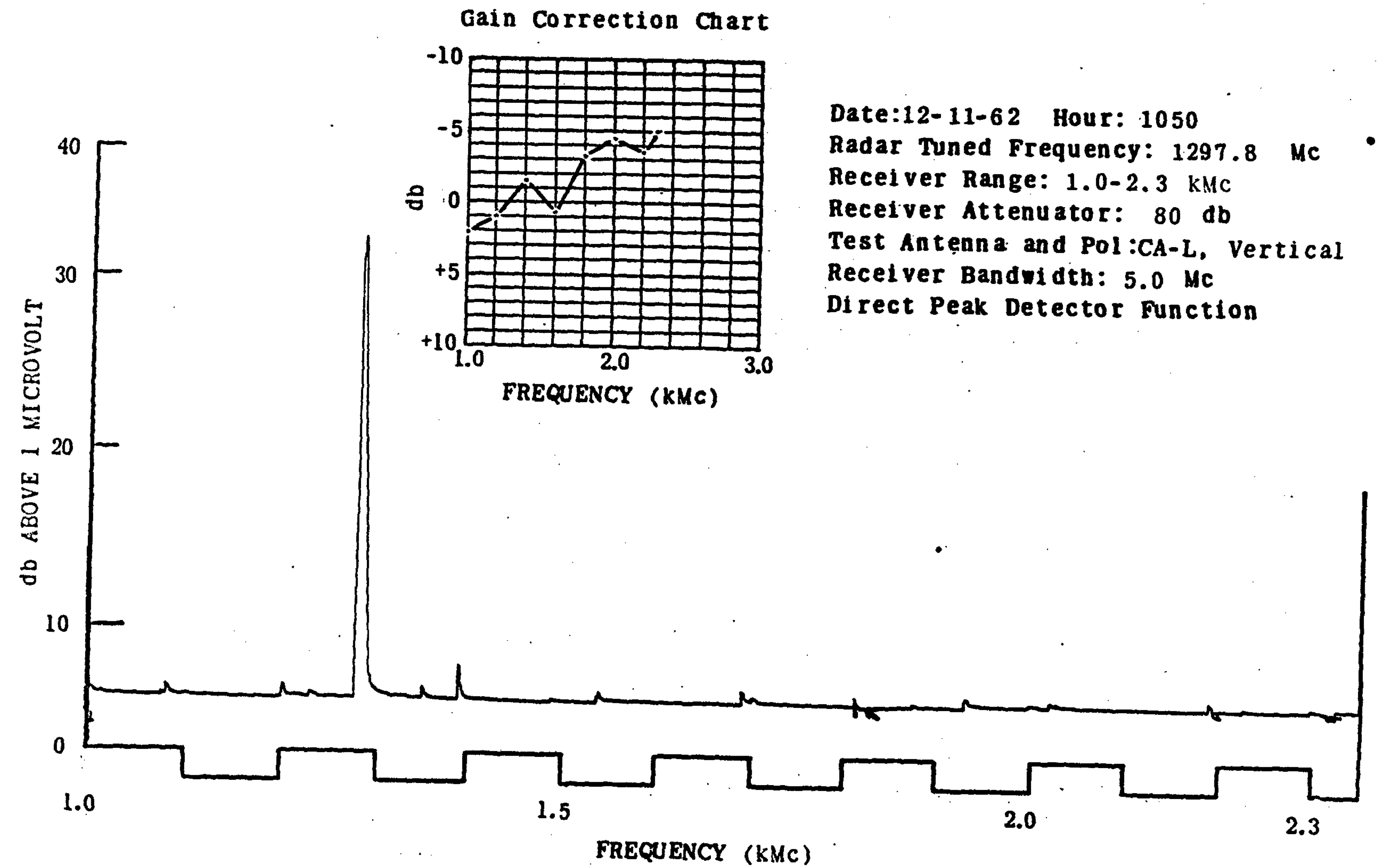


Figure 5.2.3-23. Spurious Emission Scan (f_o = 1297.8 Mc) - V, 80 db.

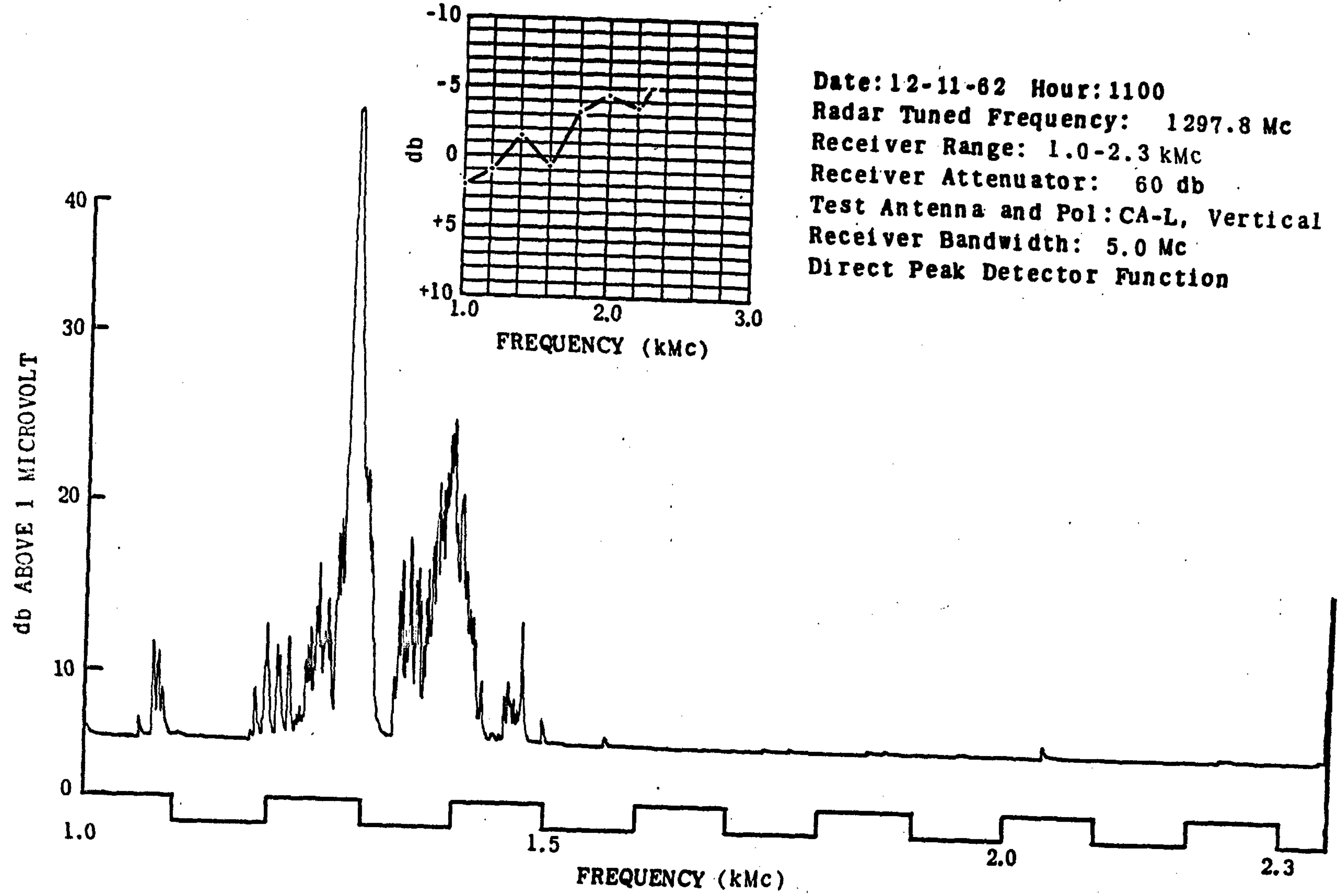


Figure 5.2.3-24. Spurious Emission Scan (f_o = 1297.8 Mc) - V, 60 db.

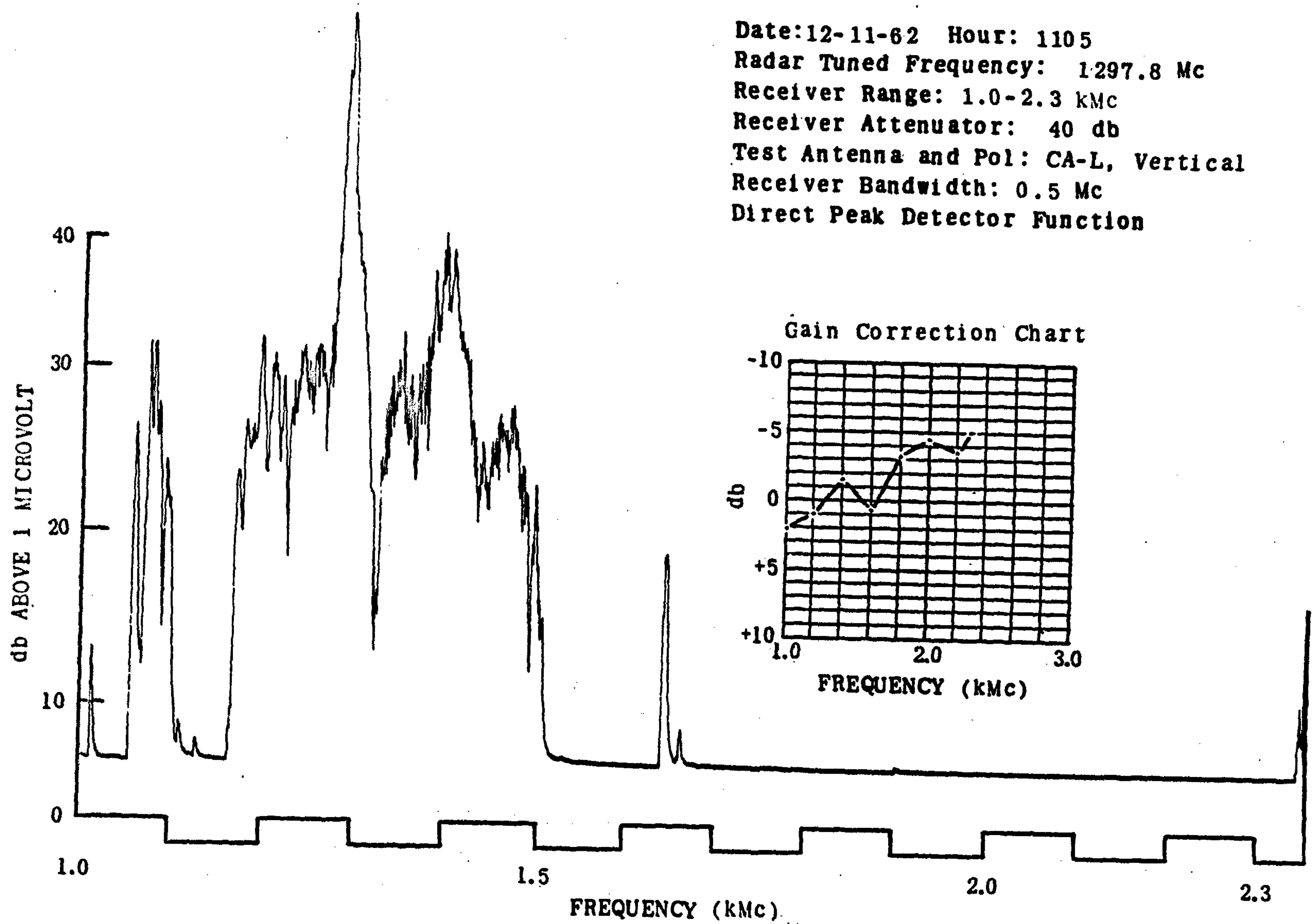


Figure 5.2.3-25. Spurious Emission Scan (f_o = 1297.8 Mc) - V, 40 db.

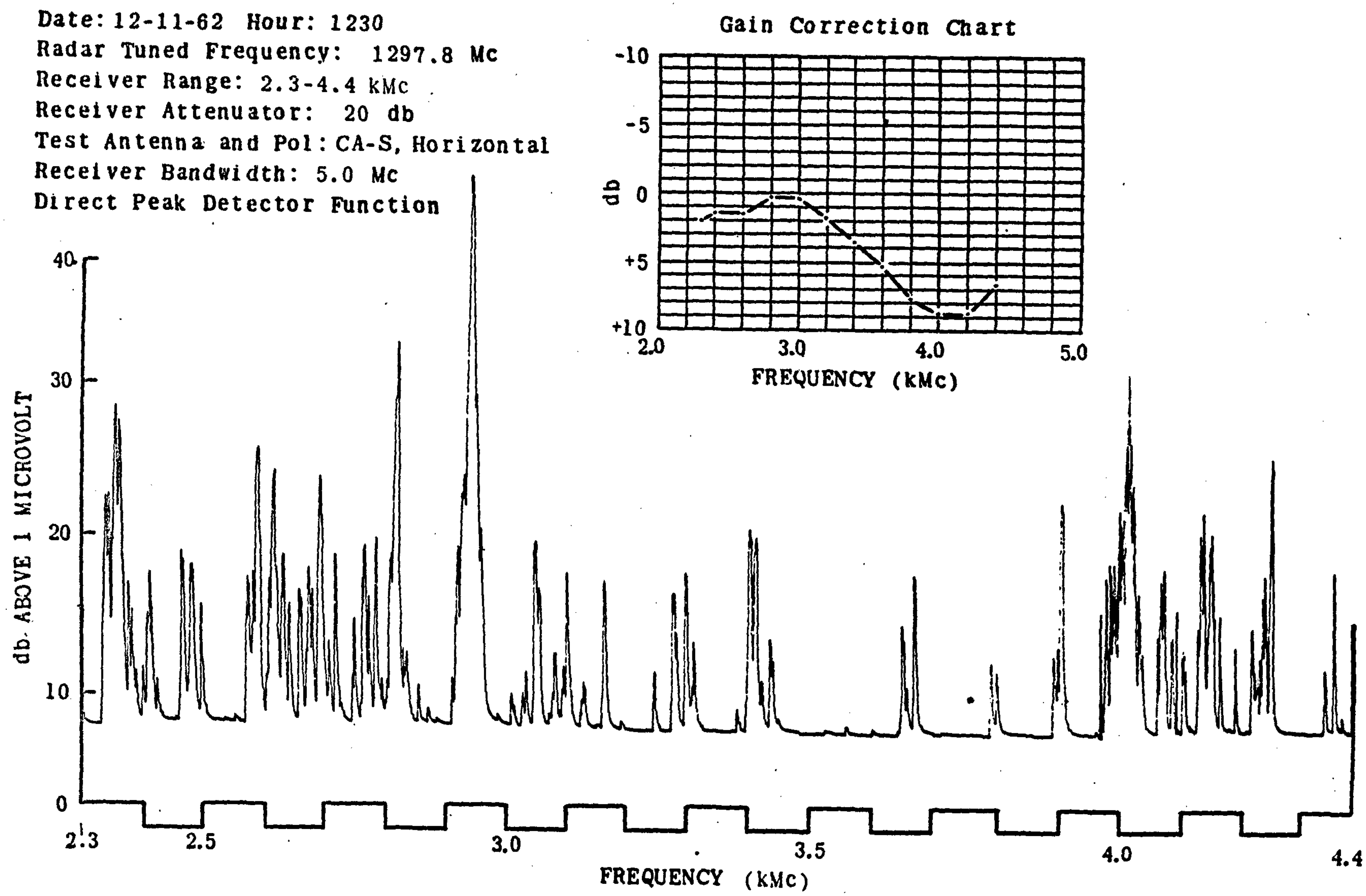


Figure 5.2.3-26. Spurious Emission Scan (f_o = 1297.8 Mc) - H, 20 db.

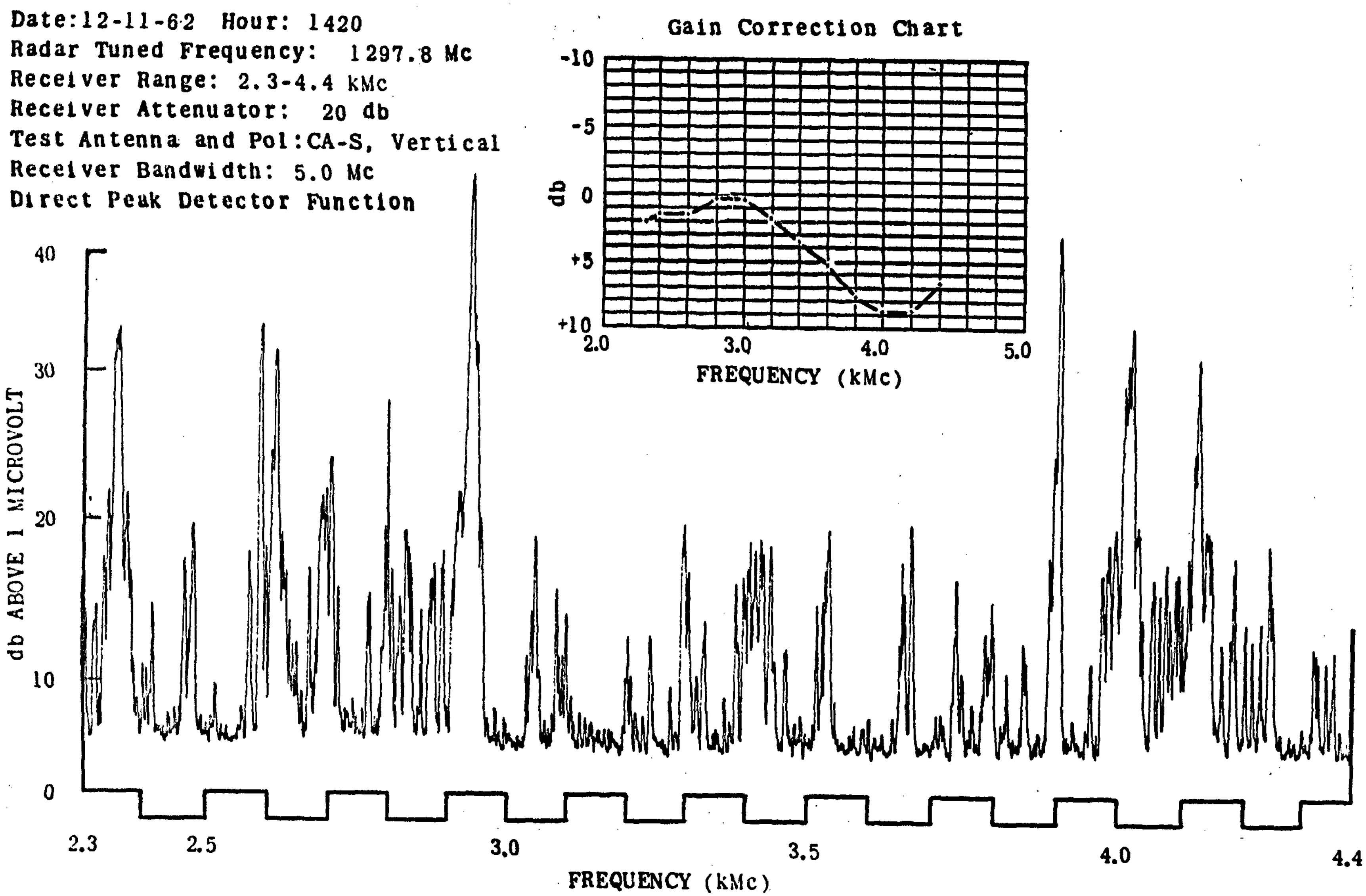


Figure 5.2.3-27. Spurious Emission Scan (f_o = 1297.8 Mc) - V, 20 db.

Date: 12-19-62 Hour: 1650
Radar Tuned Frequency: 1297.8 Mc
Receiver Range: 4.4-7.3 kMc
Receiver Attenuator: 20 db
Test Antenna and Pol: CA-M, Horizontal
Receiver Bandwidth: 0.5 Mc
Direct Peak Detector Function

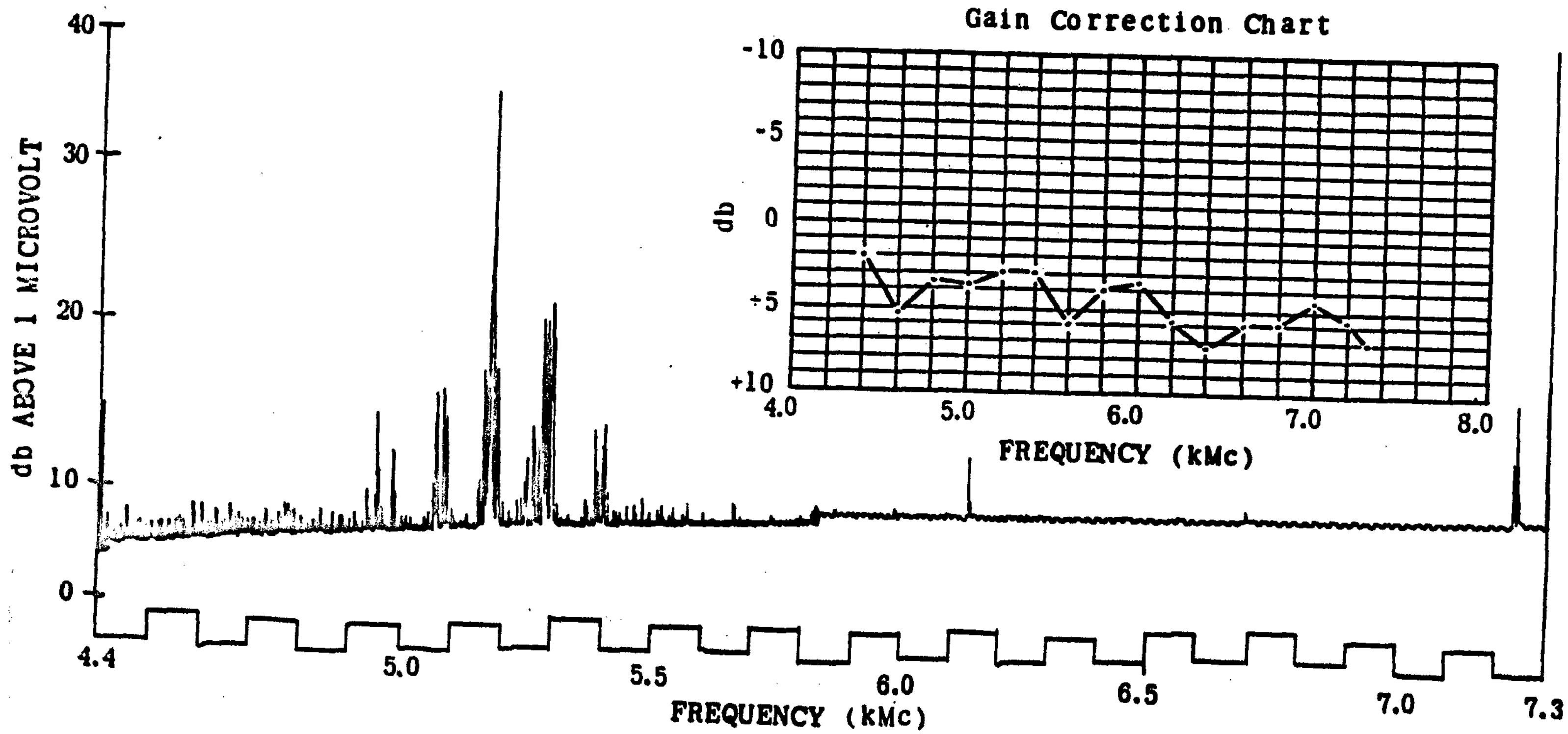


Figure 5.2.3-28. Spurious Emission Scan (f_o = 1297.8 Mc) - H, 20 db.

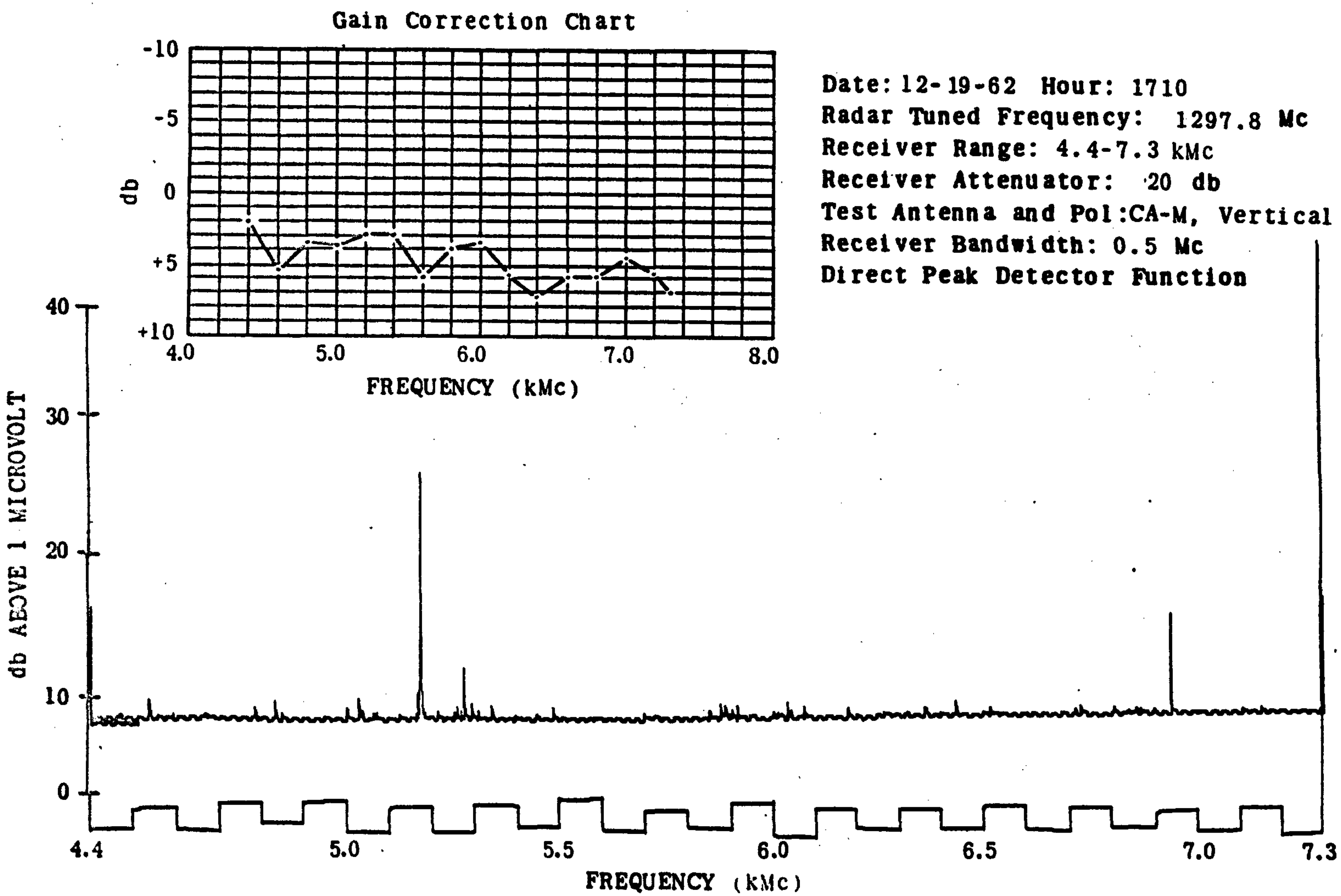


Figure 5.2.3-29. Spurious Emission Scan (f_o = 1297.8 Mc) - V, 20 db.

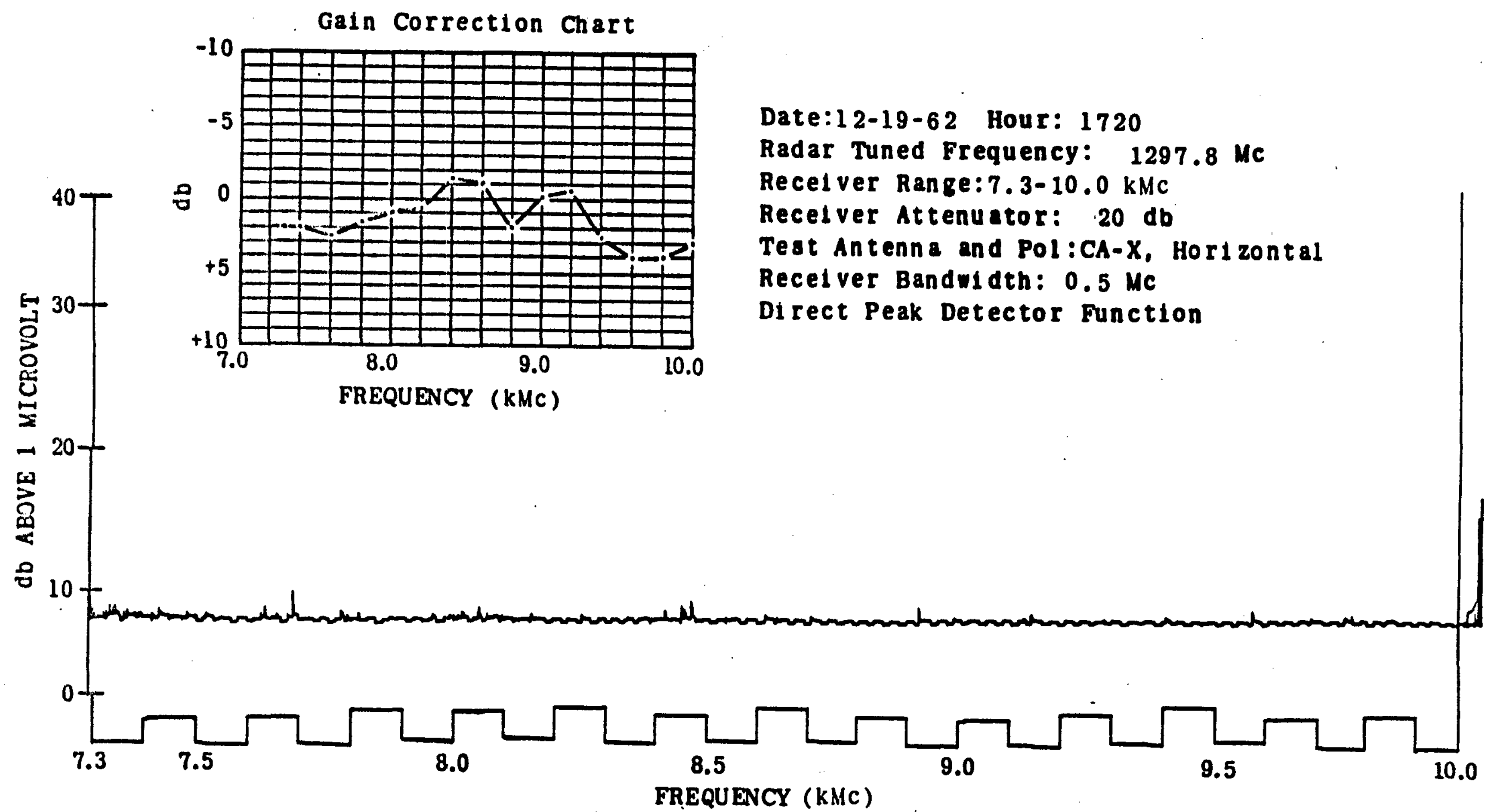


Figure 5.2.3-30. Spurious Emission Scan (f_o = 1297.8 Mc) - H, 20 db.

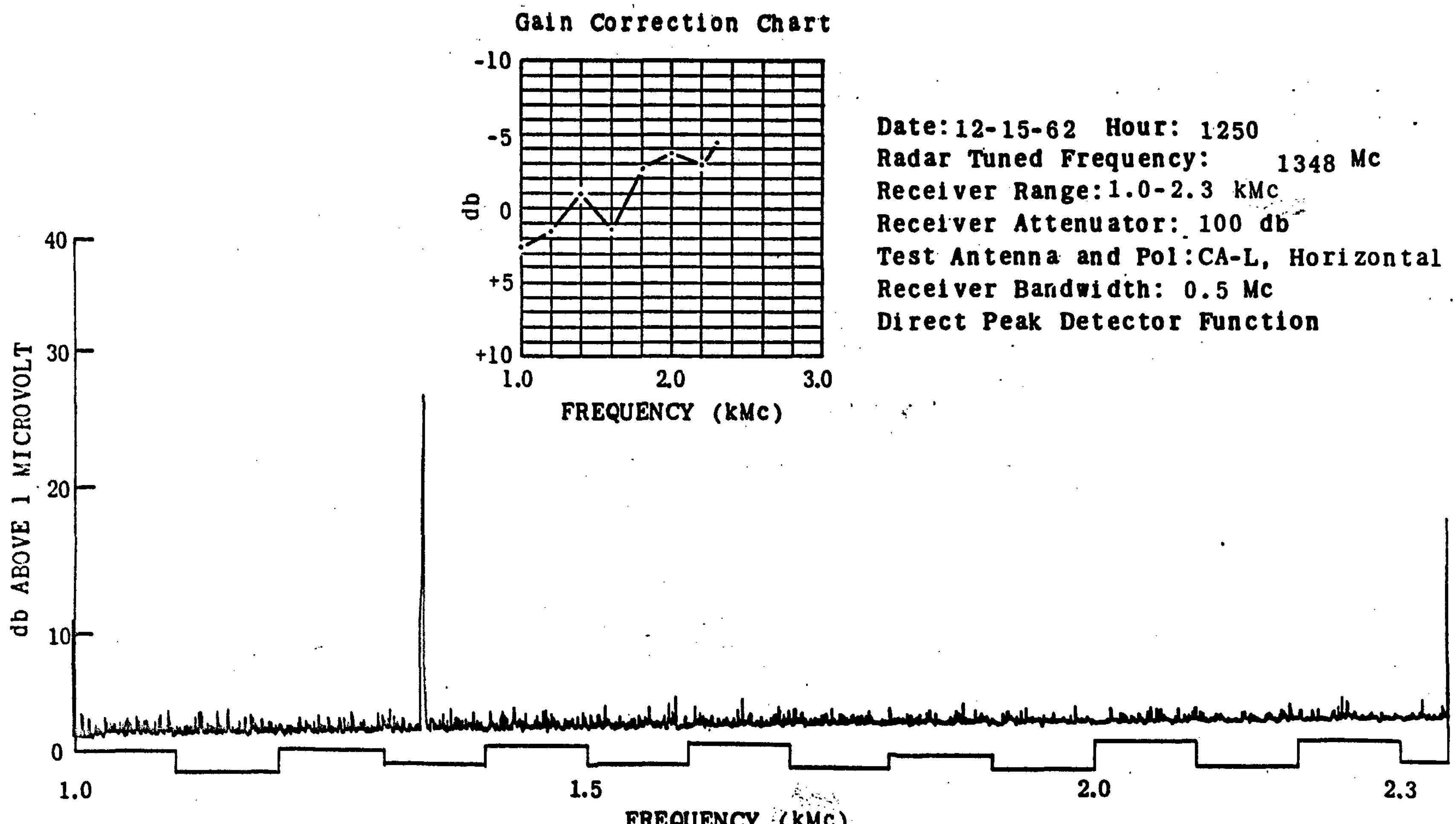


Figure 5.2.3-31. Spurious Emission Scan (f_o = 1348 Mc) - H, 100 db.

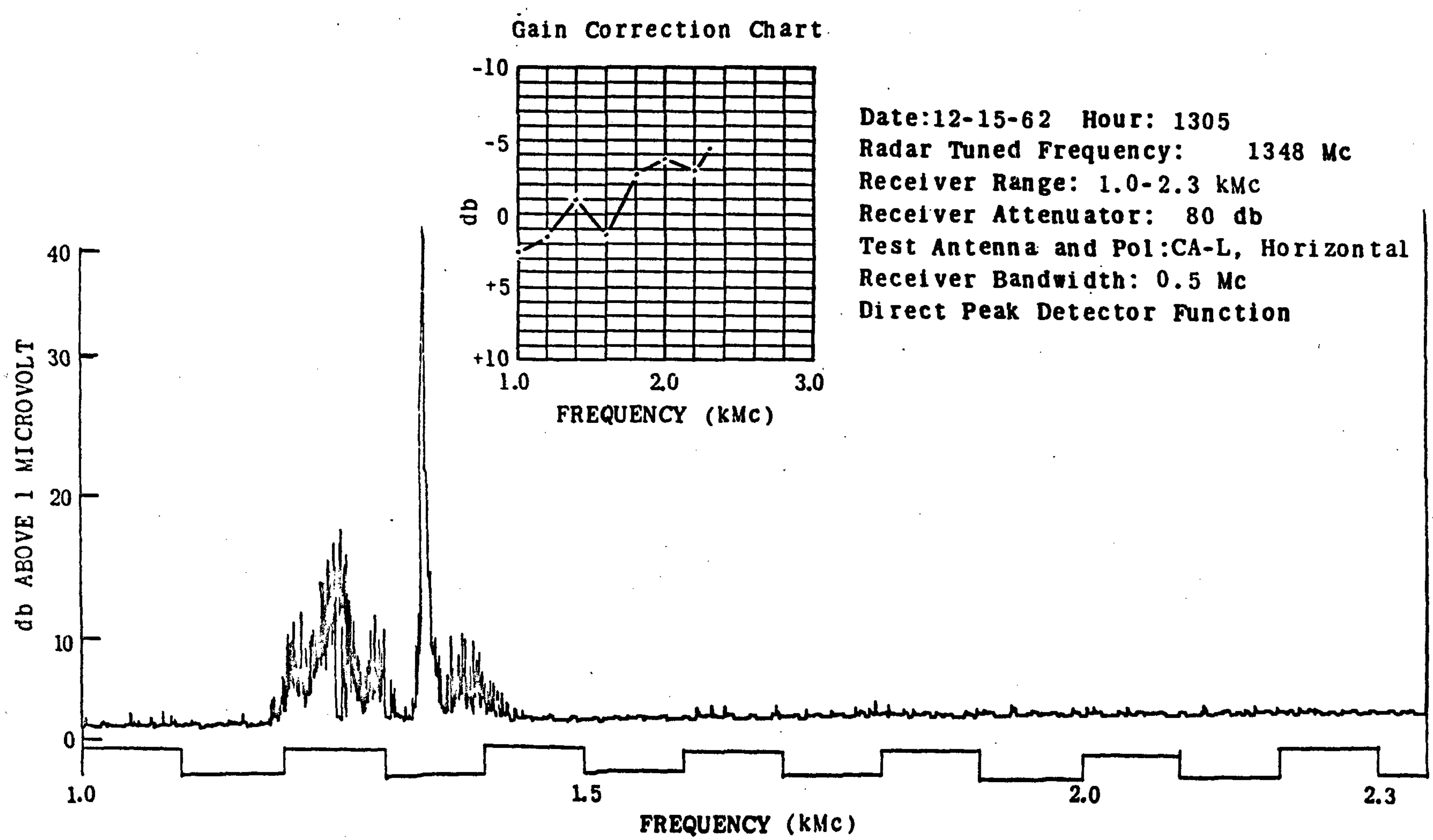


Figure 5.2.3-32. Spurious Emission Scan (f_o = 1348 Mc) - H, 80 db.

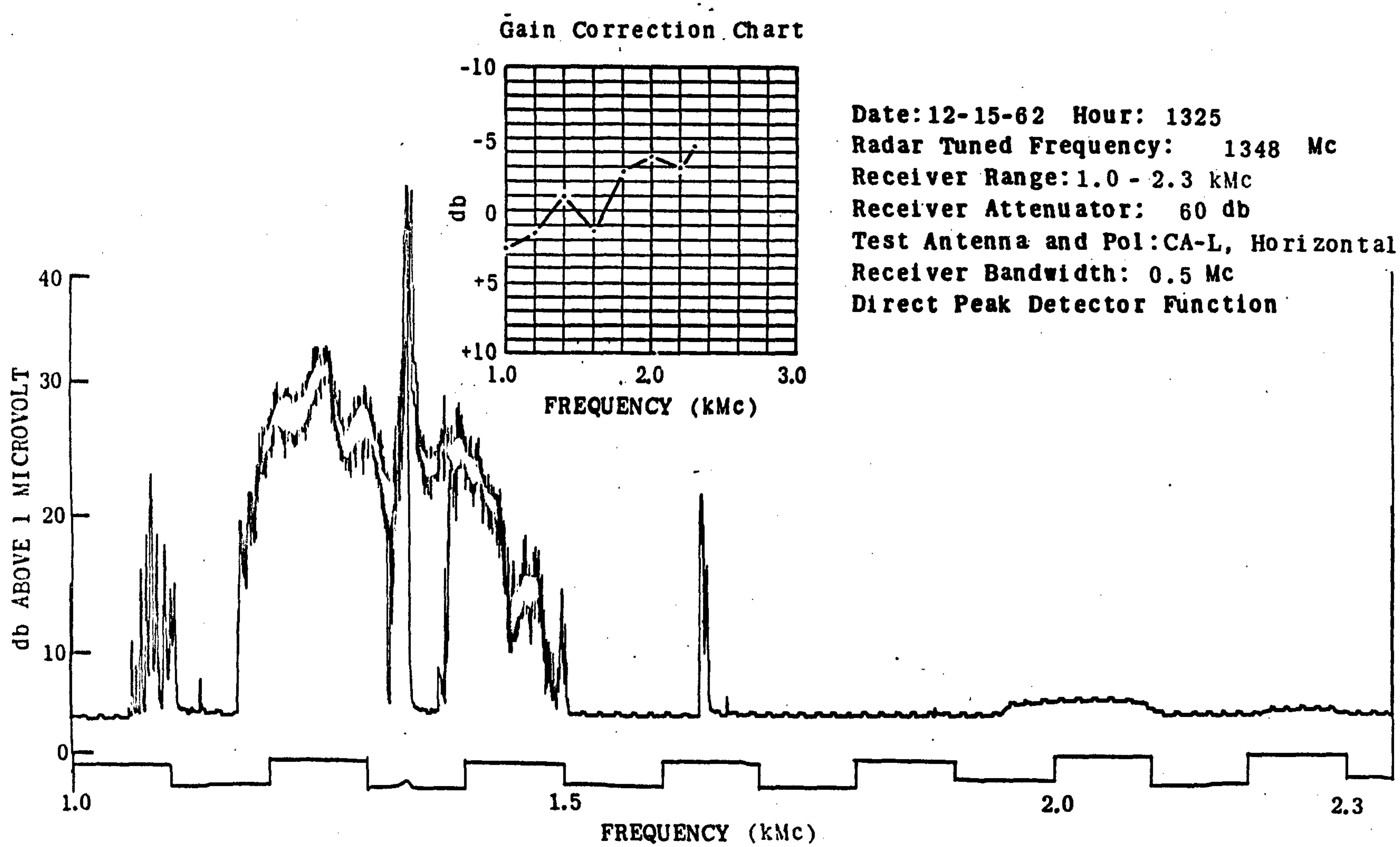


Figure 5.2.3-33. Spurious Emission Scan (f_o = 1348 Mc) - H, 60 db.

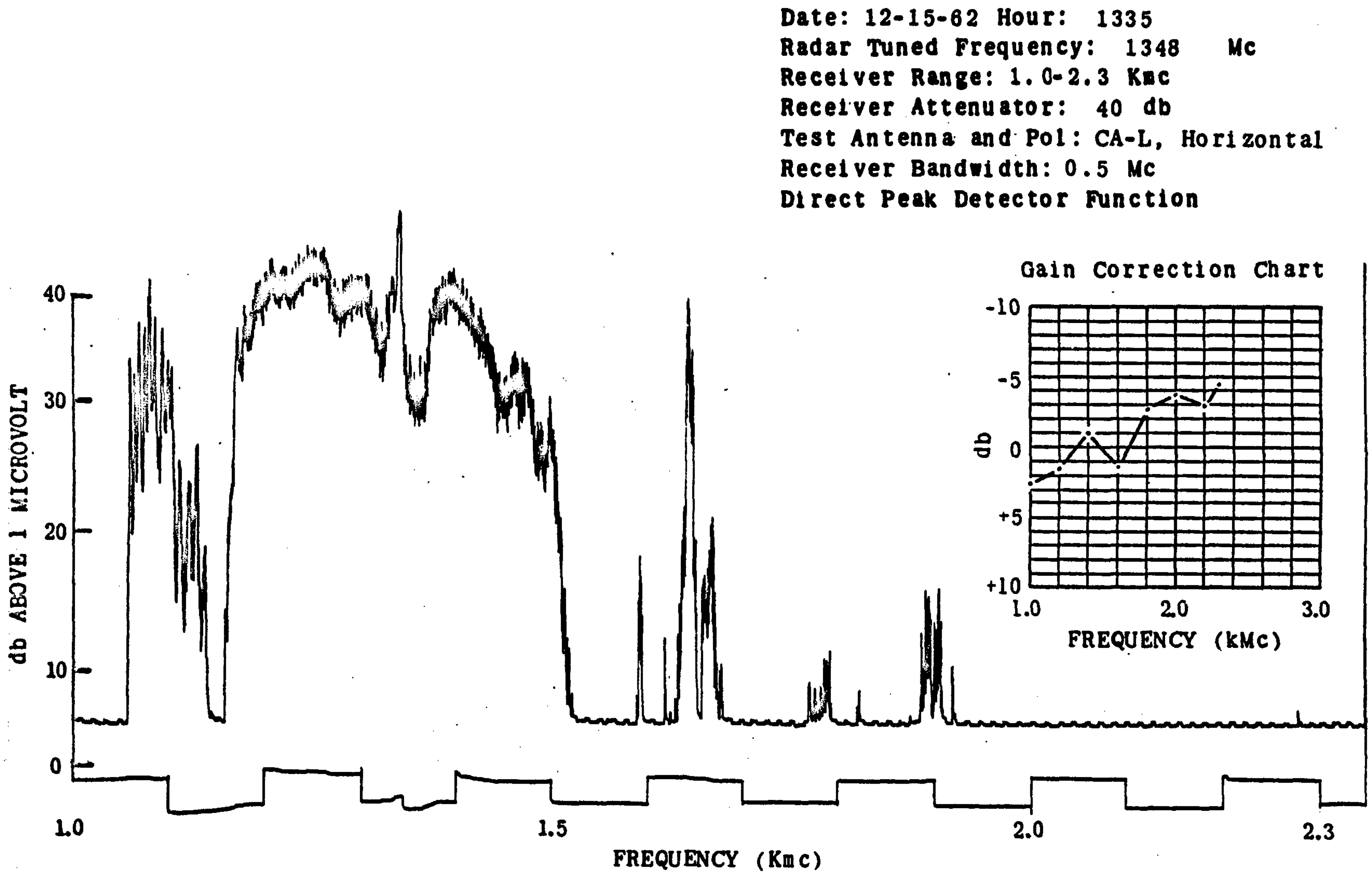


Figure 5.2.3-34. Spurious Emission Scan (f_o = 1348 Mc) - H, 40 db.

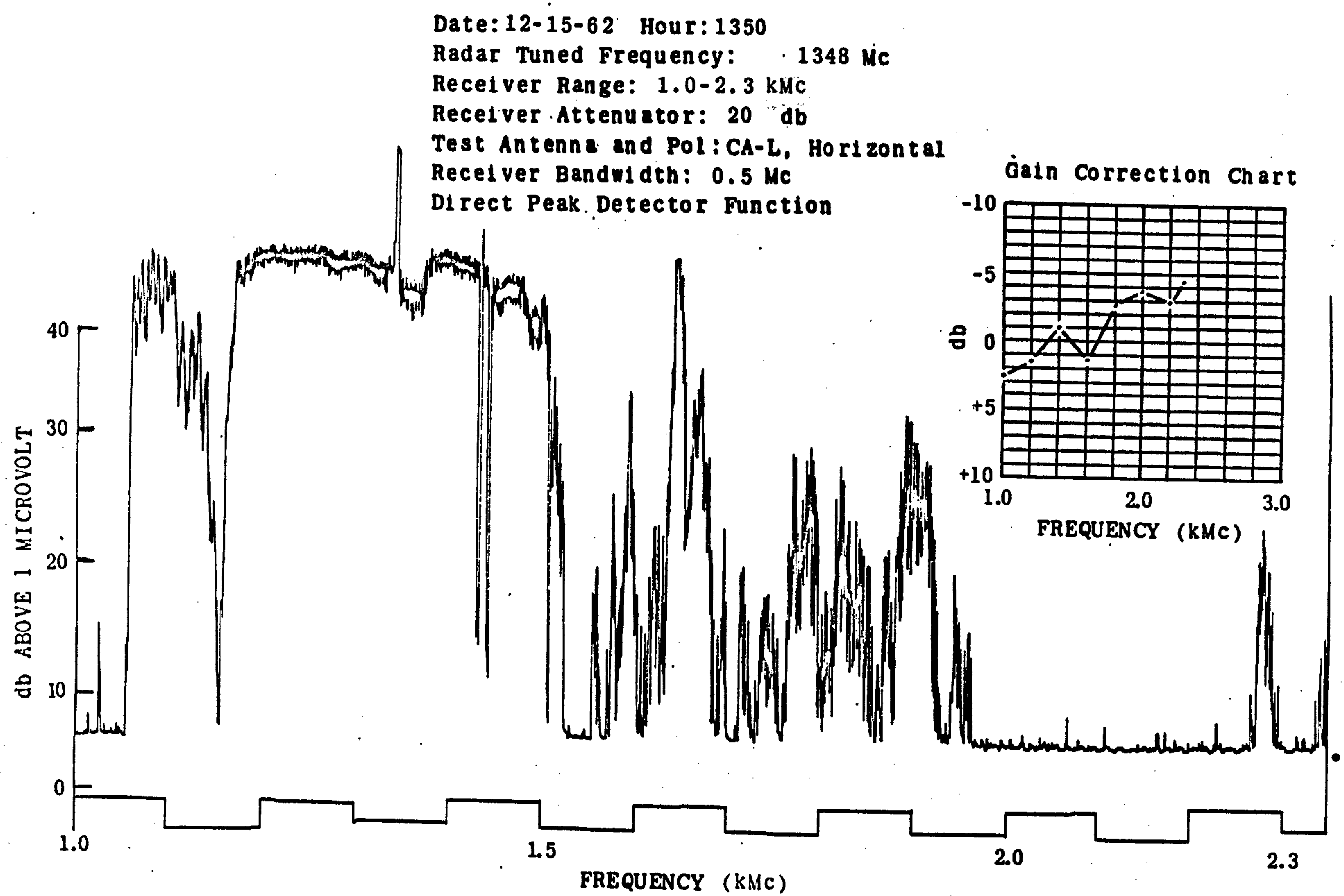


Figure 5.2.3-35. Spurious Emission Scan (f_o = 1348 Mc) - H, 20 db.

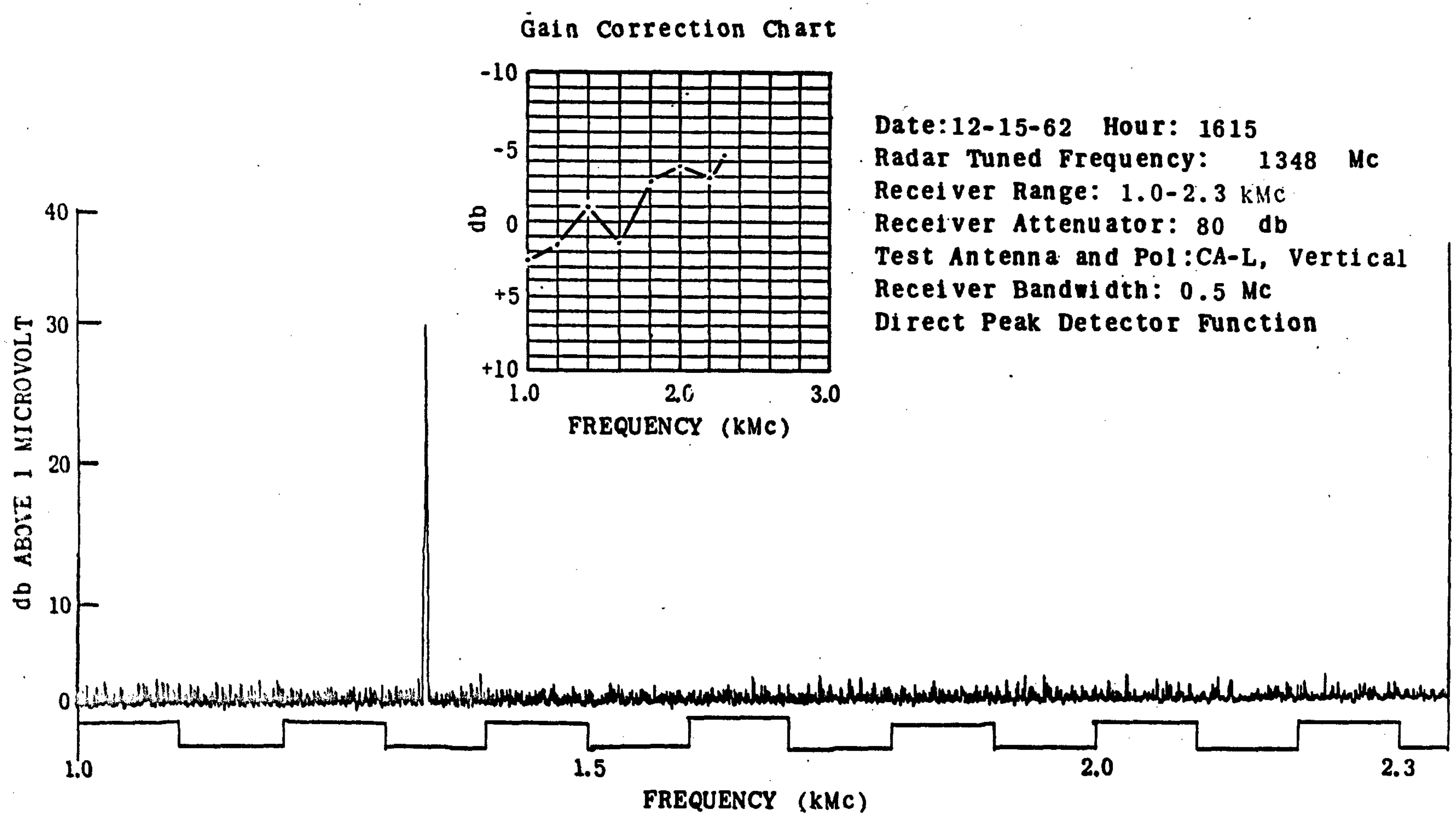


Figure 5.2.3-36. Spurious Emission Scan (f_o = 1348 Mc) - V, 80 db.

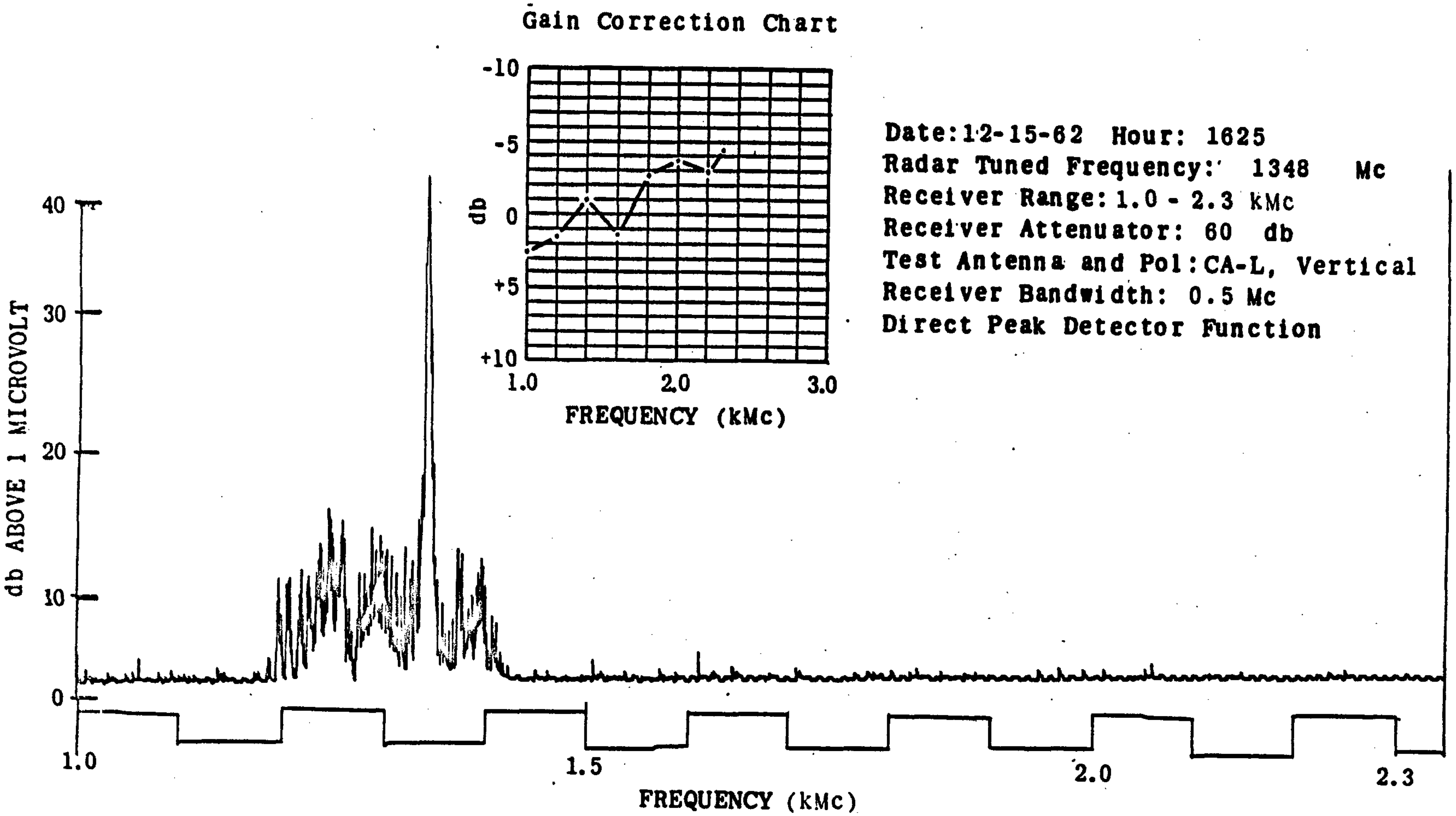


Figure 5.2.3-37. Spurious Emission Scan (f_o = 1348 Mc) - V, 60 db.

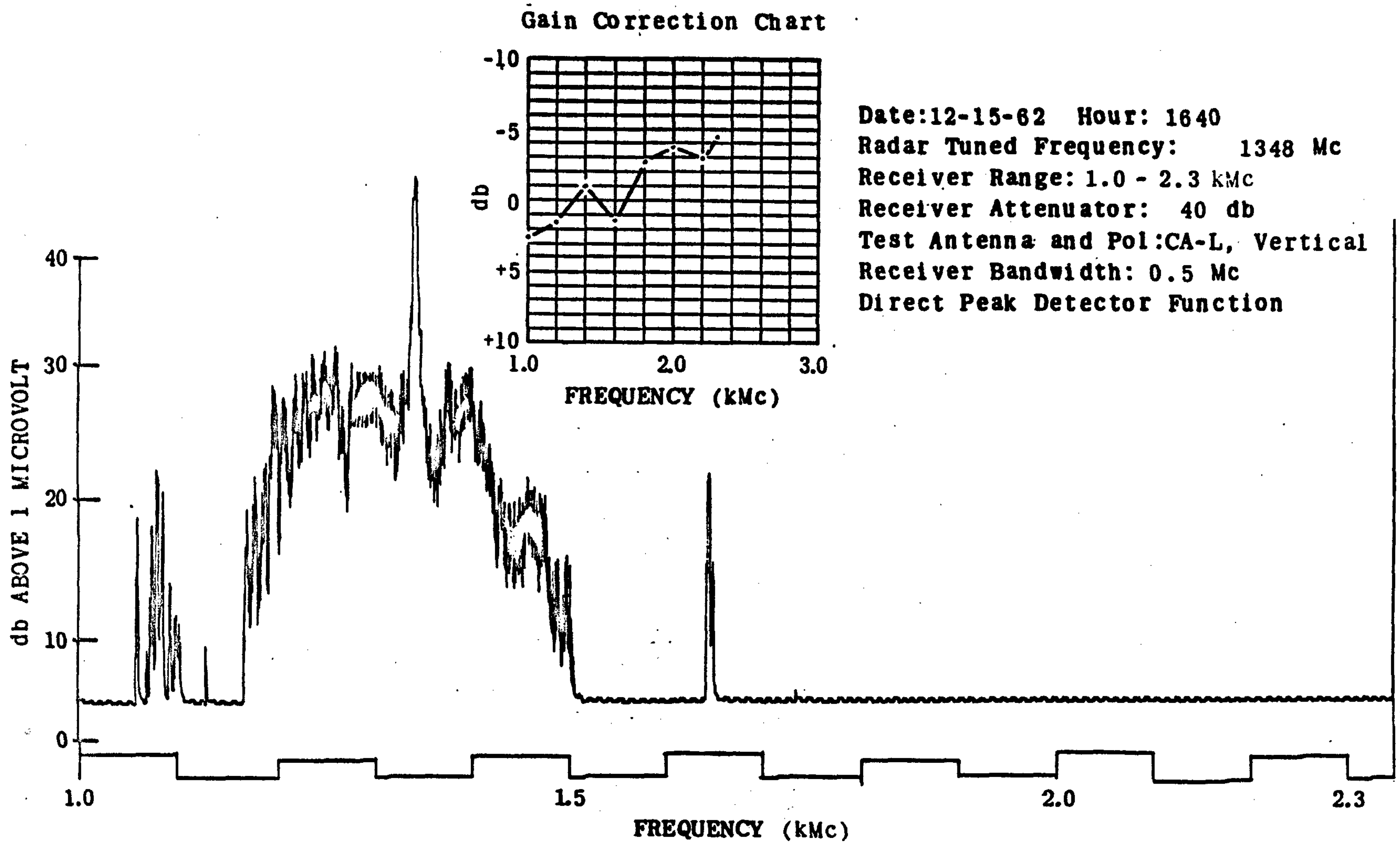


Figure 5.2.3-38. Spurious Emission Scan (f_o = 1348 Mc) - V, 40 db.

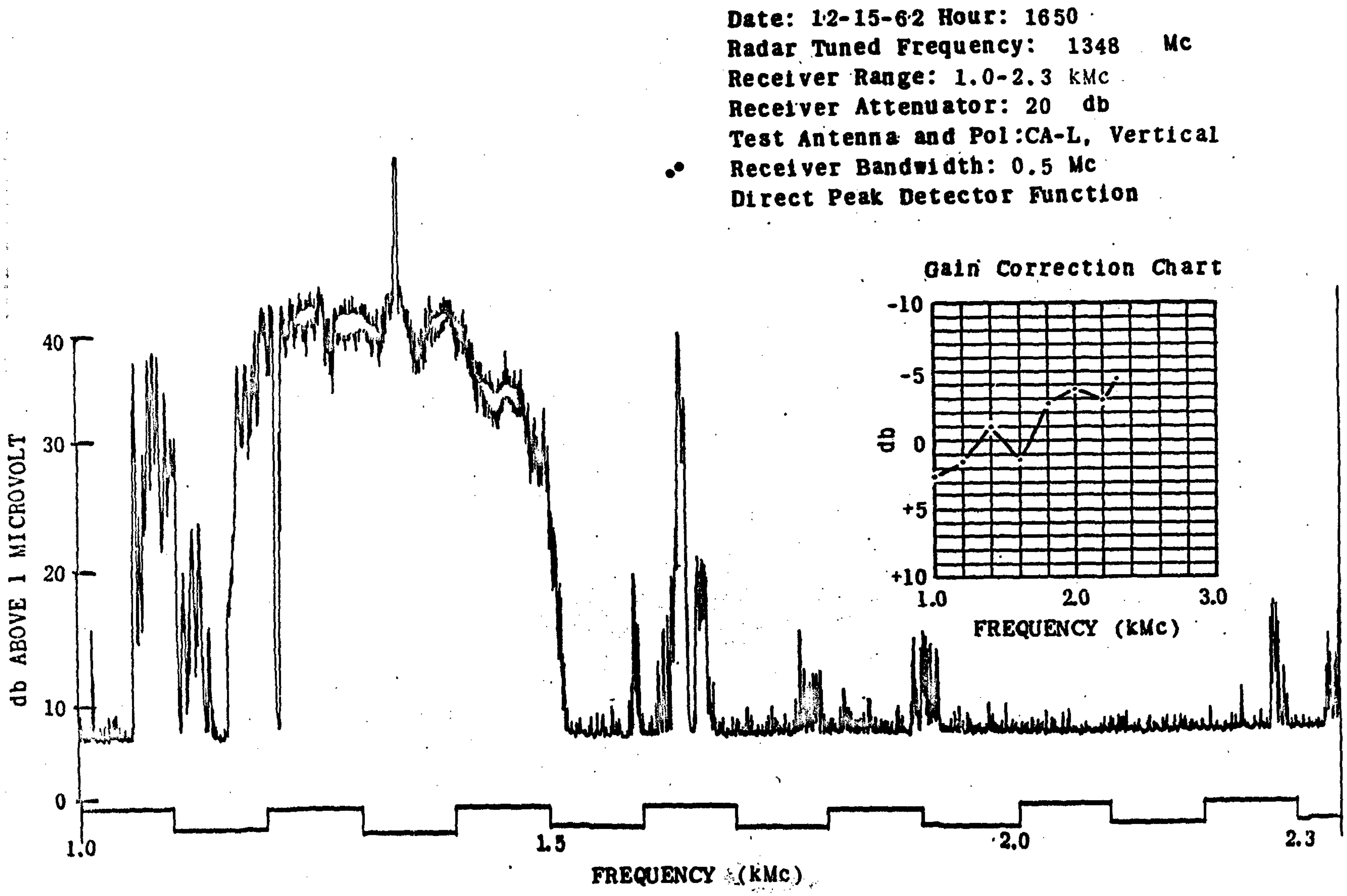


Figure 5.2.3-39. Spurious Emission Scan (f_o = 1348 Mc) - V, 20 db.

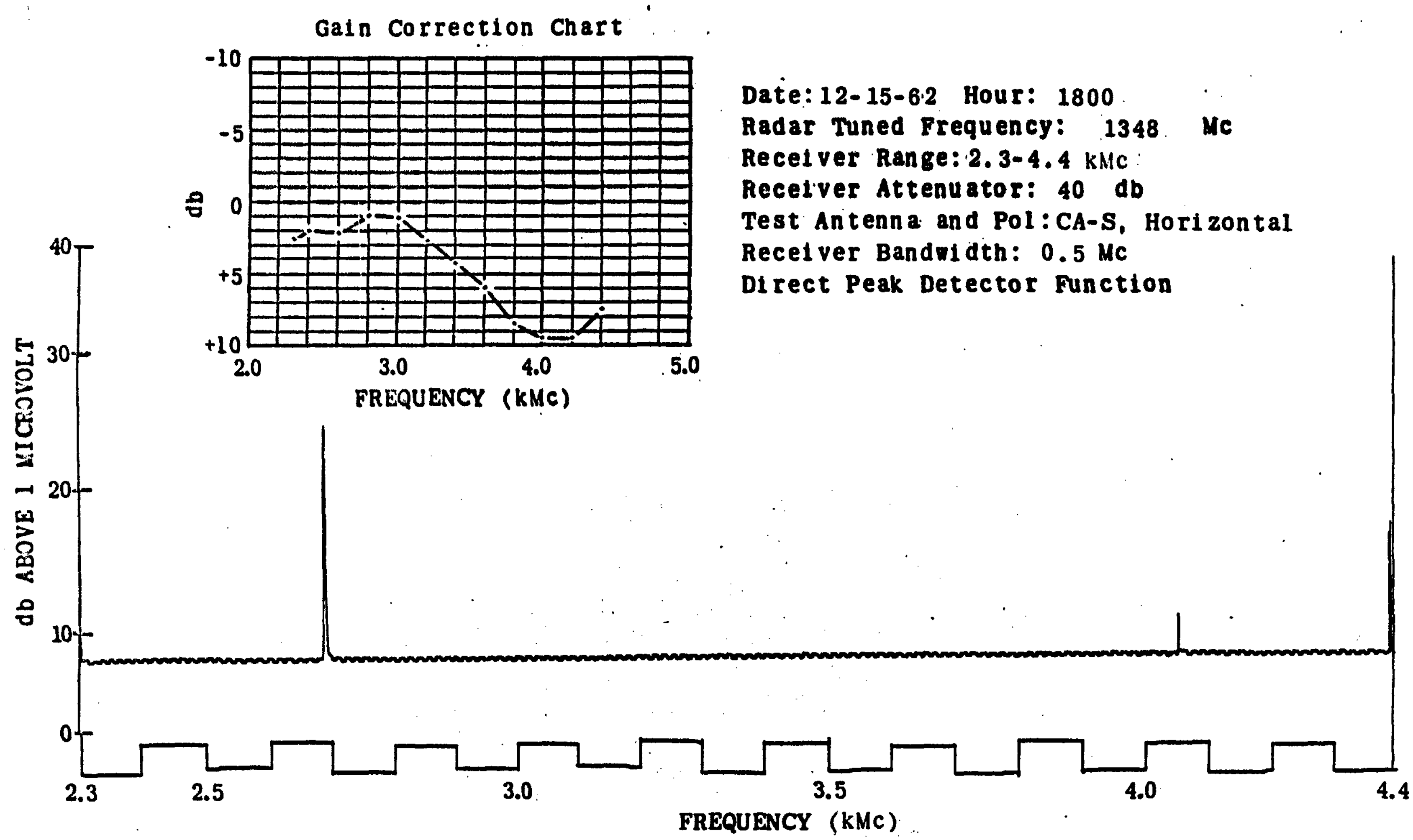


Figure 5.2.3-40. Spurious Emission Scan (f_o = 1348 Mc) - H, 40 db.

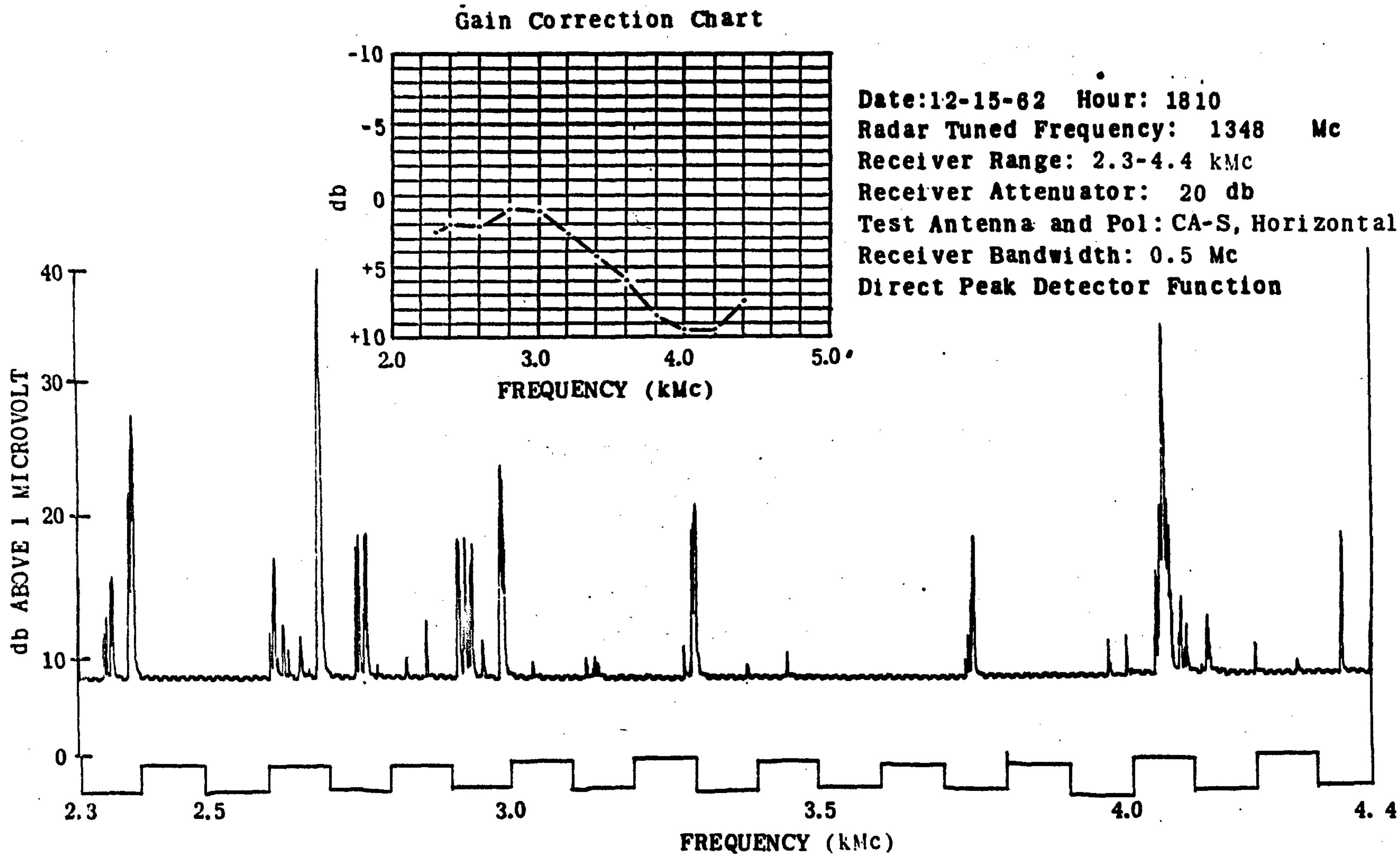


Figure 5.2.3-41. Spurious Emission Scan (f_o = 1348 Mc) - H, 20 db.

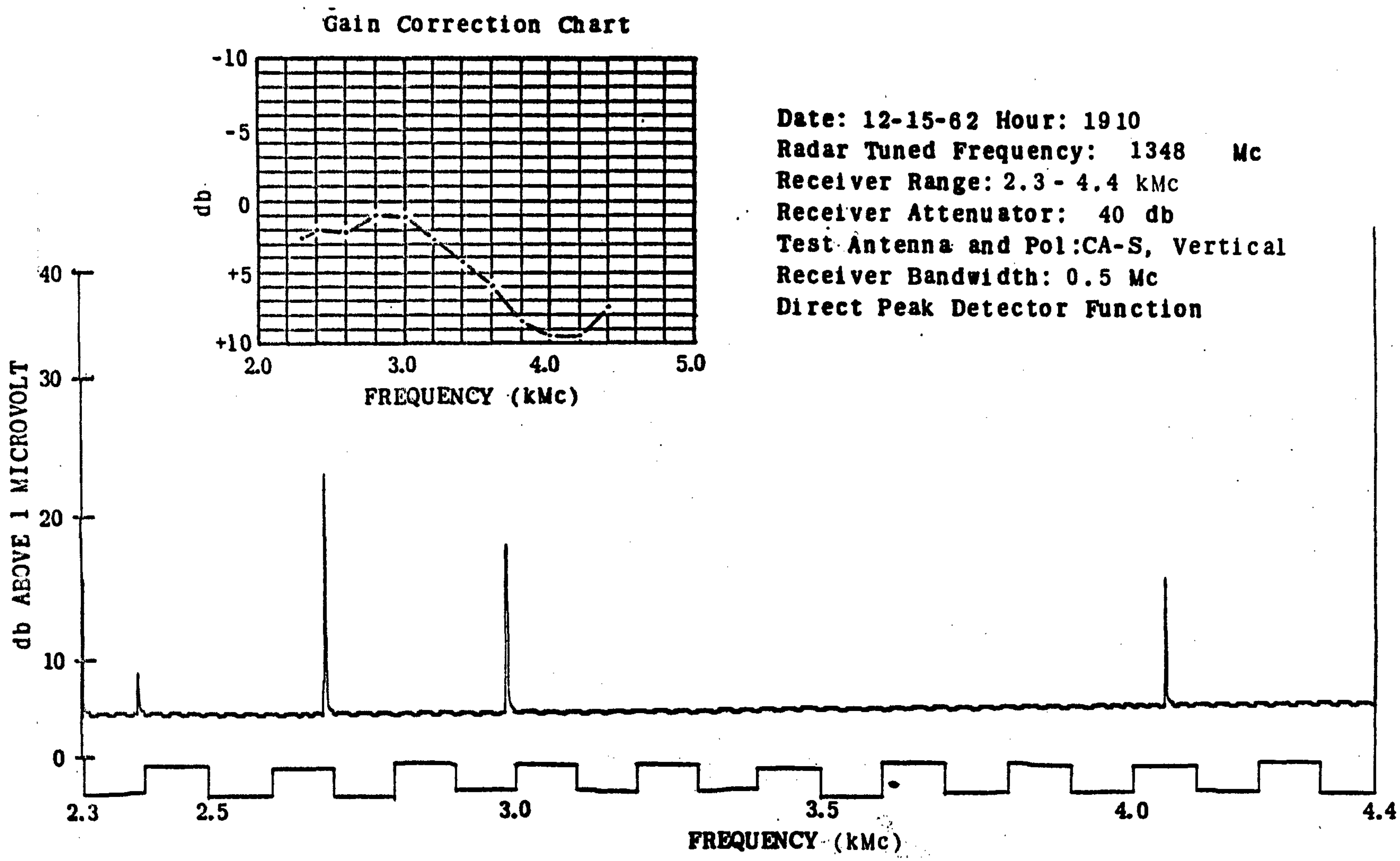


Figure 5.2.3-42. Spurious Emission Scan (f_o = 1348 Mc) - V, 40 db.

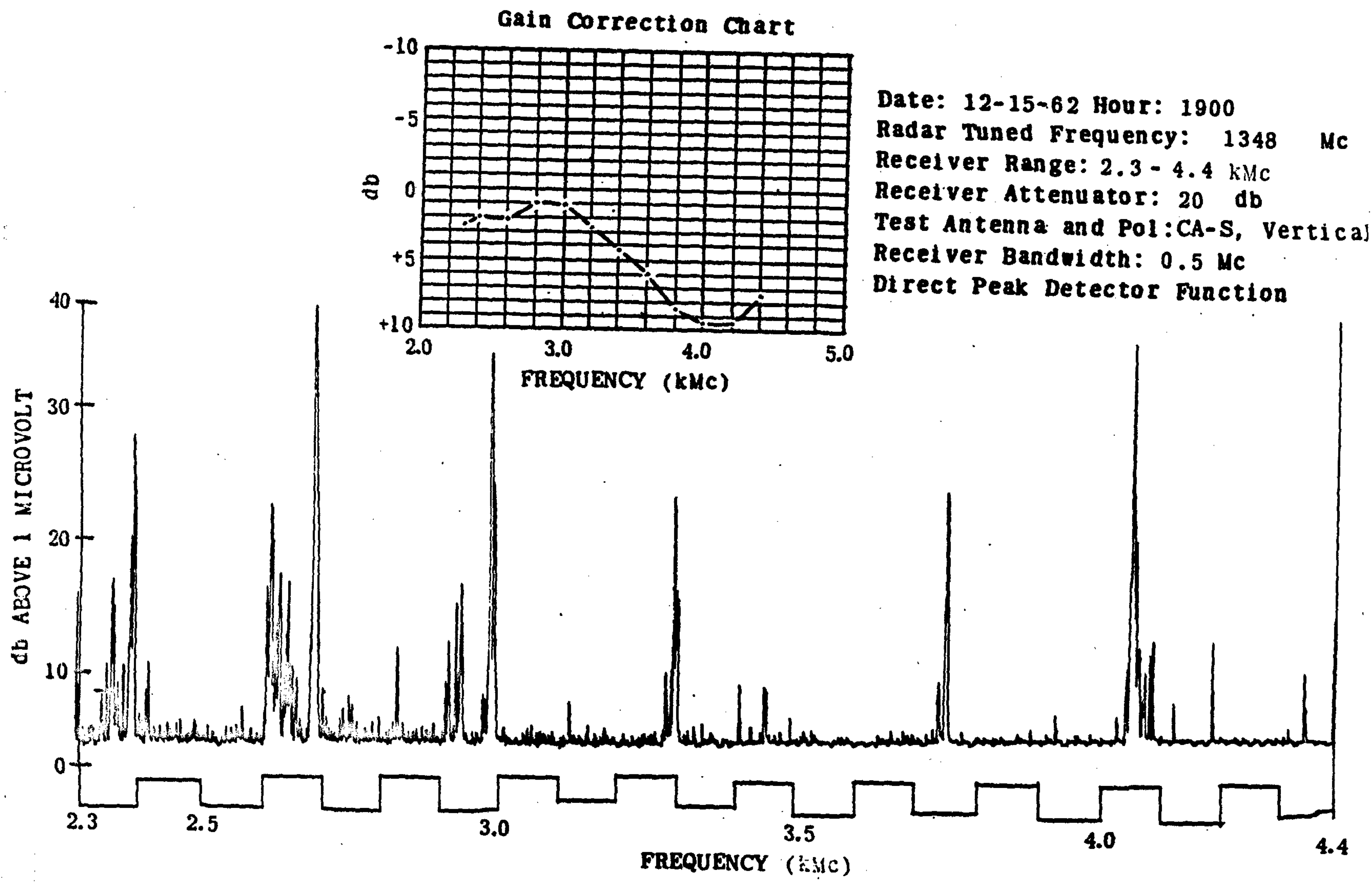


Figure 5.2.3-43. Spurious Emission Scan (f_o = 1348 Mc) - V, 20 db.

TRANSMITTER MEASUREMENTS

SPURIOUS EMISSION
(OPEN-FIELD)

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/11/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350 Xmtr. Tuned Freq. f_0(Mc): 1257.8

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B

Test Antenna Position: θ 0 ϕ 0 ω 0

Measuring Devices: Weinschel Attenuators Type 210, HP-540B, Lavoie LA-70A, Stoddart NM-62A, FXR & RLC Filters, Mosley X-Y Recorder, HP-614A

Test Antenna & Polarization: CA-L, * Horizontal

Cable Type & Length: 100' RG-260/U, 6' RG-8/U Net

	Spurious Frequency			Origin	Time of Day	Cable Loss (db)	Test Ant. Gain (db)	Atten. Inserted (db)	Sig. Gen. (dbm)	Power Density (dbm/m²)	
	Dial Reading	x	Freq. (Mc)							Peak	Avg.
*	52.42449	24	1258.2	f_o	1633	5.1	10.1	40.1	-17.2	41.3	
*	54.45610	24	1306.9		1638	5.2	10.3	20.0	-12.0	26.6	
*	48.54108	28	1357.1		1644	5.4	10.5	20.0	-19.5	19.4	
*	49.89091	28	1396.9		1652	5.5	10.8	20.0	-25.1	13.9	
*	54.25270	20	1085.1		1658	4.4	8.8	20.0	-38.9	-1.3	
*	50.64040	28	1417.9		1704	5.5	10.9	20.0	-25.0	14.0	
*	52.02040	28	1456.6		1709	5.6	11.0	20.0	-29.9	9.3	
*	52.88422	28	1480.8		1713	5.7	11.1		-24.7	-5.3	
*	52.16730	32	1669.4		1722	6.0	12.1		-45.0	-25.3	
*	49.73076	36	1790.3		1726	6.1	12.6		-57.9	-37.9	
*	52.74052	36	1898.7		1732	6.2	13.1		-53.6	-33.6	

Measurement Instructions

For each standard test frequency determine received power density for each spurious output. In "origin" column, indicate suspected spurious frequency source. Record azimuth (θ) and elevation (ϕ) angle between radar antenna boresight axis and test antenna axis for position of maximum received signal. Record angle (ω) between radar and test antenna polarization planes for position of maximum signal. Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

SPURIOUS EMISSION
(OPEN-FIELD)

Xmtr.: ARSR-1B-A **Site Code:** 5110.11 **Date:** 12/13/62

Xmtr. Serial No.: 54 **Radio Set:**

Tuning Band (Mc): 1240-1350 **Xmtr. Tuned Freq. f_o(Mc):** 1257.8

Modulation: Pulse **PW(μs):** 1.8 **PRF(pps):** 360

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B

Test Antenna Position: θ 0 ϕ 0 ω 0

Measuring Devices: Weinschel Attenuators Type 210, HP-540B, Lavoie LA-70A, Stoddart NM-62A, FXR & RLC Filters, Mosley X-Y Recorder, HP-614A

Test Antenna & Polarization: CA-L, Horizontal

Cable Type & Length: 100' RG-260/U, 6' RG-8/U Net

Spurious Frequency			Origin	Time of Day	Cable Loss (db)	Test Ant. Gain (db)	Atten. Inserted (db)	Sig. Gen. (dbm)	Power Density (dbm/m^2)	
Dial Reading	x	Freq. (Mc)							Peak	Avg.
52.44425	24	1258.7		2240	5.1	10.1	40.1	-16.1	42.4	
48.96004	28	1370.9		2246	5.4	10.6	20.0	-31.0	7.9	
49.90202	28	1397.2		2248	5.5	10.8	20.0	-26.0	13.0	
54.27526	20	1085.5		2250	4.4	8.8	20.0	-39.6	-2.0	
50.67470	28	1418.9		2252	5.5	10.9	20.0	-25.6	13.4	
52.86148	28	1479.9		2254	5.7	11.1		-30.9	-11.5	
52.17325	32	1669.5		2255	6.0	12.1		-45.9	-26.2	
49.77108	36	1791.8		2257	6.1	12.6		-57.2	-37.2	
52.72134	36	1898.0		2258	6.2	13.1		-54.8	-34.8	

Measurement Instructions

For each standard test frequency determine received power density for each spurious output. In "origin" column, indicate suspected spurious frequency source. Record azimuth (θ) and elevation (ϕ) angle between radar antenna boresight axis and test antenna axis for position of maximum received signal. Record angle (ω) between radar and test antenna polarization planes for position of maximum signal. Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

SPURIOUS EMISSION
(OPEN-FIELD)

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/14/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350 Xmtr. Tuned Freq. f_o(Mc): 1257.8

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B

Test Antenna Position: θ 0 φ 0 ω 0

Measuring Devices: Weinschel Attenuators Type 210, HP-540B Lavoie LA-70A, Stoddart NM-62A, FXR & RLC Filters Mosley X-Y Recorder, HP-614A

Test Antenna & Polarization: CA-L, Vertical

Cable Type & Length: 100' RG-260/U, 6' RG-8/U Net

Spurious Frequency			Origin	Time of Day	Cable Loss (db)	Test Ant. Gain (db)	Atten. Inserted (db)	Sig. Gen. (dbm)	Power Density (dbm/m²)	
Dial Reading	x	Freq. (Mc)							Peak	Avg.
52.41622	24	1258.0	f_o	1657	5.1	10.0		0.9	17.6	
52.45180	20	1049.0		1701	4.2	8.5		-41.2	-23.7	
54.02288	20	1080.5		1705	4.4	8.8		-49.0	-31.4	
50.11682	24	1202.8		1710	4.9	9.7		-38.5	-20.4	
50.66486	28	1418.6		1712	5.5	10.9		-27.2	-8.2	
52.18434	32	1669.9		1715	6.0	12.1		-67.1	-52.8	
53.02601	36	1908.9		1720	6.3	13.2		-72.9	-52.8	
53.25952	44	2343.4		1722	7.2	15.3		-63.9	-48.2	
49.92897	32	1597.7		1727	5.9	11.7		-64.1	-44.5	
49.81392	36	1793.3		1730	6.1	12.6		-75.6	-55.6	
52.06268	44	2290.8		1733	7.1	15.0		-70.2	-49.5	

Measurement Instructions

For each standard test frequency determine received power density for each spurious output. In "origin" column, indicate suspected spurious frequency source. Record azimuth (θ) and elevation (φ) angle between radar antenna boresight axis and test antenna axis for position of maximum received signal. Record angle (ω) between radar and test antenna polarization planes for position of maximum signal. Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

SPURIOUS EMISSION
(OPEN-FIELD)

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/14/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350 Xmtr. Tuned Freq. f_o(Mc): 1257.8

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B

Test Antenna Position: θ 0 φ 0 ω 0

Measuring Devices: Weinschel Attenuators Type 210, HP 540B, Lavoie LA-70A, Stoddart NM-62A, FXR & RLC Filters, Mosley X-Y Recorder, HP-616B,

Test Antenna & Polarization: CA-S, *Horizontal, Vertical

Cable Type & Length: 100' RG-260/U, 6' RG-8/U

	Spurious Frequency			Origin	Time of Day	Cable Loss (db)	Test Ant. Gain (db)	Atten. Inserted (db)	Sig. Gen. (dbm)	Power Density (dbm/m²)	
	Dial Reading	x	Freq. (Mc)							Peak	Avg.
*	52.40912	48	2515.6	2fo	1830	7.5	16.8		-42.1	-22.0	
*	52.40200	72	3772.9	3fo	1835	10.3	19.3		-46.0	-22.1	
	52.39968	48	2515.2	2fo	1941	7.5	16.8		-44.0	-23.9	
	52.40096	72	3772.9	3fo	1944	10.3	19.3		-51.4	-27.5	

Measurement Instructions

For each standard test frequency determine received power density for each spurious output. In "origin" column, indicate suspected spurious frequency source. Record azimuth (θ) and elevation (φ) angle between radar antenna boresight axis and test antenna axis for position of maximum received signal. Record angle (ω) between radar and test antenna polarization planes for position of maximum signal. Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

SPURIOUS EMISSION (OPEN-FIELD)

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/9/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350 Xmtr. Tuned Freq. f_o(Mc): 1297.8

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Significant Control Positions: Radar Antenna Circular Polarization

Transmitter B

Test Antenna Position: θ 0 ϕ 0 ω 0

Measuring Devices: Weinschel Attenuators Type 210, HP-540B

Lavoie LA-70A, Stoddart NM-62A, FXR & RLC Filters,

Mosley X-Y Recorder, HP-614A

Test Antenna & Polarization: CA-L, * Horizontal

Cable Type & Length: 100' RG-260/U, 6' RG-8/U Net

	Spurious Frequency									Power Density (dbm/m²)	
	Dial Reading	X	Freq. (Mc)	Origin	Time of Day	Cable Loss (db)	Test Ant. Gain (db)	Atten. Inserted (db)	Sig. Gen. (dbm)	Peak	Avg.
*	54.05602	24	1297.7	f_o	1024	5.2	10.2	40	-22.1	36.5	
*	54.29913	20	1085.0		1115	4.4	8.8		-21.0	-3.4	
*	49.88631	24	1197.4		1120	4.9	9.6		-12.4	5.9	
*	49.93169	28	1398.0		1127	5.5	10.8		-14.7	4.3	
*	51.48333	32	1647.4		1134	6.0	12.0		-33.9	-14.2	
*	52.74432	36	1898.6		1138	6.2	13.1		-51.5	-31.3	

Measurement Instructions

For each standard test frequency determine received power density for each spurious output. In "origin" column, indicate suspected spurious frequency source. Record azimuth (θ) and elevation (ϕ) angle between radar antenna boresight axis and test antenna axis for position of maximum received signal. Record angle (ω) between radar and test antenna polarization planes for position of maximum signal. Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

SPURIOUS EMISSION
(OPEN-FIELD)

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/10/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350 Xmtr. Tuned Freq. f_0(Mc): 1297.8

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Significant Control Positions: Radar Antenna, Linear Polarization (Horizontal) Transmitter B

Test Antenna Position: θ 0 ϕ 0 ψ 0

Measuring Devices: Weinschel Attenuators Type 210, HP-540B, LA-70A, Stoddart NM-62A, FXR & BLC Filters, Mosley X-Y Recorder, HP-614A

Test Antenna & Polarization: CA-L, *Horizontal, Vertical

Cable Type & Length: 100' RG-260/U, 6' RG-8/U Net

Spurious Frequency			Origin	Time of Day	Cable Loss (db)	Test Ant. Gain (db)	Atten. Inserted (db)	Sig. Gen. (dbm)	Power Density (dbm/m²)	
Dial Reading	x	Freq. (Mc)							Peak	Avg.
* 54.07271	24	1297.7	f_0	1410	5.2	10.2	40.1	-18.9	39.8	
* 45.22718	24	1085.4		1420	4.4	8.8		-19.0	-1.4	
* 49.91712	24	1198.0		1422	4.9	9.6		-15.5	2.8	
* 49.91301	24	1397.6		1427	5.5	10.8		-15.0	4.0	
* 51.45352	24	1646.5		1429	5.9	12.0		-35.1	-15.5	
* 52.73546	24	1898.4		1432	6.2	13.1		-51.0	-31.0	
		Date:	12/11/62							
54.01331	20	1030.3		1114	4.4	8.8		-43.2	-25.6	
50.15607	24	1203.7		1116	4.9	9.7		-40.8	-22.6	
54.07513	24	1297.8	f_0	1124	5.2	10.2	20.0	-20.8	17.8	
50.12436	28	1403.5		1128	5.5	10.8		-38.0	-19.0	
51.45028	32	1646.4		1131	5.9	12.0		-60.1	-40.5	

Measurement Instructions

For each standard test frequency determine received power density for each spurious output. In "origin" column, indicate suspected spurious frequency source. Record azimuth (θ) and elevation (ϕ) angle between radar antenna boresight axis and test antenna axis for position of maximum received signal. Record angle (ψ) between radar and test antenna polarization planes for position of maximum signal. Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

SPURIOUS EMISSION
(OPEN-FIELD)

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/11/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350 Xmtr. Tuned Freq. f_o(Mc): 1297.8

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Significant Control Positions: Radar Antenna, Linear Polarization (Horizontal) Transmitter B

Test Antenna Position: θ 0 ϕ 0 ω 0

Measuring Devices: Weinschel Attenuators Type 210, HP-540B, Lavoie LA-70A, Stoddart NM-62A, FXR & RLC Filters Mosley X-Y Recorder, HP-616B

Test Antenna & Polarization: CA-S *Horizontal, Vertical

Cable Type & Length: 100' RG-260/U, 6' RG-8/U Net

	Spurious Frequency			Origin	Time of Day	Cable Loss (db)	Test Ant. Gain (db)	Atten. Inserted (db)	Sig. Gen. (dbm)	Power Density (dbm/m²)	
	Dial Reading	x	Freq. (Mc)							Peak	Avg.
*	53.69808	44	2362.7		1243	7.2	16.5		-59.2	-39.7	
*	54.05417	48	2594.6	$2f_o$	1250	7.6	17.0		-55.0	-34.7	
*	50.41500	56	2823.2		1303	7.9	17.5		-66.8	-46.0	
*	52.58532	56	2944.8		1317	8.1	17.7		-40.6	-19.4	
*	49.97740	68	3398.5		1325	9.3	18.6		-69.0	-46.3	
*	54.05700	72	3892.1	$3f_o$	1336	10.5	19.6		-56.8	-32.7	
*	50.05474	80	4004.4		1340	10.8	19.8		-53.0	-23.6	
	53.68164	44	2362.0		1427	7.2	16.5		-55.5	-36.0	
	54.03072	48	2595.9	$2f_o$	1430	7.6	17.0		-58.0	-37.7	
	52.58189	56	2944.6		1436	8.1	17.7		-42.9	-21.7	
	54.06338	72	3892.6	$3f_o$	1438	10.5	19.6		-43.5	-19.4	
	50.05144	80	4004.1		1440	10.8	19.8		-52.1	-27.7	
	51.55828	80	4124.7			11.0	20.1		-48.9	-24.3	

Measurement Instructions

For each standard test frequency determine received power density for each spurious output. In "origin" column, indicate suspected spurious frequency source. Record azimuth (θ) and elevation (ϕ) angle between radar antenna boresight axis and test antenna axis for position of maximum received signal. Record angle (ω) between radar and test antenna polarization planes for position of maximum signal. Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

SPURIOUS EMISSION
(OPEN-FIELD)

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/15/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350 Xmtr. Tuned Freq. f_o(Mc): 1348

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B

Test Antenna Position: θ 0 ϕ 0 ω 0

Measuring Devices: Weinschel Attenuators Type 210, HP-540B Lavoie LA-70A, Stoddart NM-62A, FXR & RLC Filters, Mosley X-Y Recorder, HP-614A

Test Antenna & Polarization: CA-L, *Horizontal, Vertical

Cable Type & Length: 100' RG-260/U, 6' RG-8/U Net

	Spurious Frequency			Origin	Time of Day	Cable Loss (db)	Test Ant. Gain (db)	Atten. Inserted (db)	Sig. Gen. (dbm)	Power Density (dbm/m²)	
	Dial Reading	x	Freq. (Mc)							Peak	Avg.
*	48.15077	28	1348.2	fo	1414	5.3	10.5	40.1	-20.5	38.4	
*	54.27158	20	1085.4		1417	4.4	8.8		-23.2	-5.6	
*	52.77026	24	1266.5		1424	5.1	10.1		-10.9	7.5	
*	50.07856	28	1402.2		1429	5.5	10.8		-20.0	-1.0	
*	51.39182	32	1644.5		1433	5.9	11.9		-23.9	-4.2	
*	52.65214	36	1895.5		1435	6.2	13.1		-56.2	-36.2	
	48.14094	28	1357.9	fo	1706	5.3	10.5	10	-11.0	17.8	
	54.25268	20	1085.1		1708	4.4	8.8		-15.9	1.7	
	52.74250	24	1265.8		1710	5.1	10.1		-33.4	-20.0	
	50.04970	28	1401.4		1711	5.5	10.8		-40.2	-21.2	
	51.38481	32	1644.3		1713	5.9	11.9		-44.5	-24.8	
	53.06550	36	1910.4		1716	6.2	13.1		-73.2	-58.1	

Measurement Instructions

For each standard test frequency determine received power density for each spurious output. In "origin" column, indicate suspected spurious frequency source. Record azimuth (θ) and elevation (ϕ) angle between radar antenna boresight axis and test antenna axis for position of maximum received signal. Record angle (ω) between radar and test antenna polarization planes for position of maximum signal. Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

SPURIOUS EMISSION
(OPEN-FIELD)

Xmtr.: ARSR-1B-A Site Code: 5110.11 Date: 12/15/62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band (Mc): 1240-1350 Xmtr. Tuned Freq. f_o(Mc): 1348

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B

Test Antenna Position: θ 0 ϕ 0 ω 0

Measuring Devices: Weinschel Attenuators Type 210, HP-540B, Lavoie LA-70A, Stoddart NM-62A, FXR & RLC Filters

Mosley X-Y Recorder, HP-616B

Test Antenna & Polarization: CA-S, *Horizontal, Vertical

Cable Type & Length: 100' RG-260/U, 6' RG-8/U Net

Spurious Frequency			Origin	Time of Day	Cable Loss (db)	Test Ant. Gain (db)	Atten. Inserted (db)	Sig. Gen. (dbm)	Power Density (dbm/m^2)	
Dial Reading	x	Freq. (Mc)							Peak	Avg.
* 48.10954	56	2694.1	2fo	1816	7.8	17.2		-43.0	-22.4	
* 48.12750	84	4042.7	3fo	1822	10.9	19.9		-42.3	-17.8	
48.12702		2695.1	2fo	1914	7.8	17.2		-47.0	-26.4	
48.11426		4041.6	3fo	1916	10.9	19.9		-45.5	-21.0	

Measurement Instructions

For each standard test frequency determine received power density for each spurious output. In "origin" column, indicate suspected spurious frequency source. Record azimuth (θ) and elevation (ϕ) angle between radar antenna boresight axis and test antenna axis for position of maximum received signal. Record angle (ω) between radar and test antenna polarization planes for position of maximum signal. Use reverse side for block diagram and remarks.

5.2.4 Emission Spectrum

Emission spectrum measurements consist of measuring the general amplitude distribution of the spectral components of a pulse signal. The spectrum of a pulse signal is the power versus frequency distribution of a pulse about the fundamental or spurious frequencies of the transmitter.

Emission spectrum measurements were made at the test site with the radar transmitter tuned to each of the standard test frequencies of 1257.8 Mc, 1297.8 Mc, and 1348 Mc. An attempt was made to measure each of the spurious signals recorded in the spurious emission test (5.2.3); however, some of these signals were too weak to photograph.

The procedure for the emission spectrum measurement is as follows. Initially, the output of the sampled signal is adjusted so that no overload exists. A convenient amplitude reference is established with a variable external RF attenuator and the analyzer gain setting. The picture is photographed, and the width of the sweep measured without changing the spectrum analyzer control settings. A signal generator's CW output is substituted for the spurious frequency and the spectrum analyzer vertical divisions calibrated in dbm. The RF attenuation inserted in the antenna leads which is not calibrated out by the signal generator must be recorded. In order to obtain more detail on the skirts of a strong signal, the dynamic range of the spectrum analyzer is exploited by taking out some of the external RF attenuation to bring up the skirts. This new presentation is photographed and the spectrum analyzer calibrated in the same manner as the first picture. Additional emission spectrum pictures may be made by taking out more attenuation. Attenuation should not be taken out beyond the point where the spectrum analyzer overloads. The sweep width is usually widened on the second and third cuts in order to show the detail on the skirts. In this report, the spectrum analyzer calibration is plotted alongside the photograph. The data scaled from the photograph of each spurious emission are recorded on separate data sheets. Where more than one cut is required on strong signals, the data from all the cuts are used to plot a composite emission spectrum curve.

These emission spectrum curves are plotted as power density per kilocycle bandwidth versus frequency. Computations must be made in order to convert the scaled data in dbm to power density. The spectral power density at the various frequencies in the spectrum is computed in the same manner as the power density in the spurious emission test. Power density in this test is obtained per kilocycle bandwidth. Figure 5.2.5-1 shows a block diagram of the measurement setup. Signal power available (P_A) at the test antenna terminals is the sum of the signal generator output plus the net cable losses plus any attenuation inserted in the antenna lead to attenuate the radar signal. Net cable losses are the difference between the losses in the test cable and the losses in the calibrating cable from the signal generator. In equation form, the power available at the test antenna terminals is

$P_{A(dbm)}$ = signal generator output (dbm), plus net cable loss (db), plus attenuation inserted (db)

The spectral power density (P_D) at the test antenna terminals is then

$$P_{D(dbm/m^2/kc)} = P_A/A/kc$$

where

kc = bandwidth of measuring instrument in kilocycles

A = effective area of test antenna = $\lambda^2 G/4\pi$

G = power gain of test antenna over an isotropic antenna

λ = wavelength of received spurious signal

= $300/f_{mc}$ meters

f_{mc} = frequency in megacycles

therefore,

$$P_{D(dbm/m^2/kc)} = 10 \log P_A/A/kc$$

$$= 10 \log P_A - 10 \log A - 10 \log kc$$

$$= 10 \log P_A - 10 \log(\lambda^2 G/4\pi) - 10 \log kc$$

$$= 10 \log P_A - 10 \log 300^2/4\pi + 20 \log f_{mc}$$
$$- 10 \log G - 10 \log kc$$

$$= 10 \log P_A - 38.6 + 20 \log f_{mc} - 10 \log G$$
$$- 10 \log kc$$

As an example, computations will be made for one point on the spectral power density curve of the 1257.8 Mc emission of the radar. The spectral power densities on the first three data sheets are derived from data scaled from the photographs shown in Figure 5.2.4-2. The point selected is on the eleventh (11) line of the second data sheet. The point selected is the highest amplitude in the first cut. The signal generator output scaled from the photograph is -39 dbm. The net cable loss is obtained from Section 4.5.4. 30 db of attenuation was inserted in the antenna lead to attenuate the radar signal. These two figures are added to the signal generator output to give the power (P_A) at the antenna terminals. The equation for the spectral power density is

$$P_{D(dbm/m^2/kc)} = 10 \log P_A - 38.6 + 20 \log f_{mc}$$
$$- 10 \log G - 10 \log kc$$

where

$10 \log P_A$ = signal generator (dbm) plus cable loss (db) plus attenuation inserted (db)

$= -39 \text{ dbm} + 5.1 \text{ db} + 30 \text{ db} = -3.9 \text{ dbm}$

$20 \log f_{mc} = 20 \log 1257.8 = 62 \text{ db}$

$10 \log G = 10 \text{ db}$

$10 \log kc = 10 \log 20 = 13 \text{ db}$

Therefore,

$$P_D = -3.9 \text{ dbm} - 38.6 \text{ db} + 62 \text{ db} - 10 \text{ db} - 13 \text{ db}$$
$$= -3.5 \text{ dbm/m}^2\text{/kc}$$

The composite curve for this radar emission for all the points is seen in Figure 5.2.4-11.

Emission spectrum photographs of spurious emissions are shown in Figures 5.2.4-2 through 5.2.4-10. Data scaled from these photographs are recorded on 20 data sheets. Composite curves of emission spectral distribution are plotted in Figures 5.2.4-11 through 5.2.4-25.

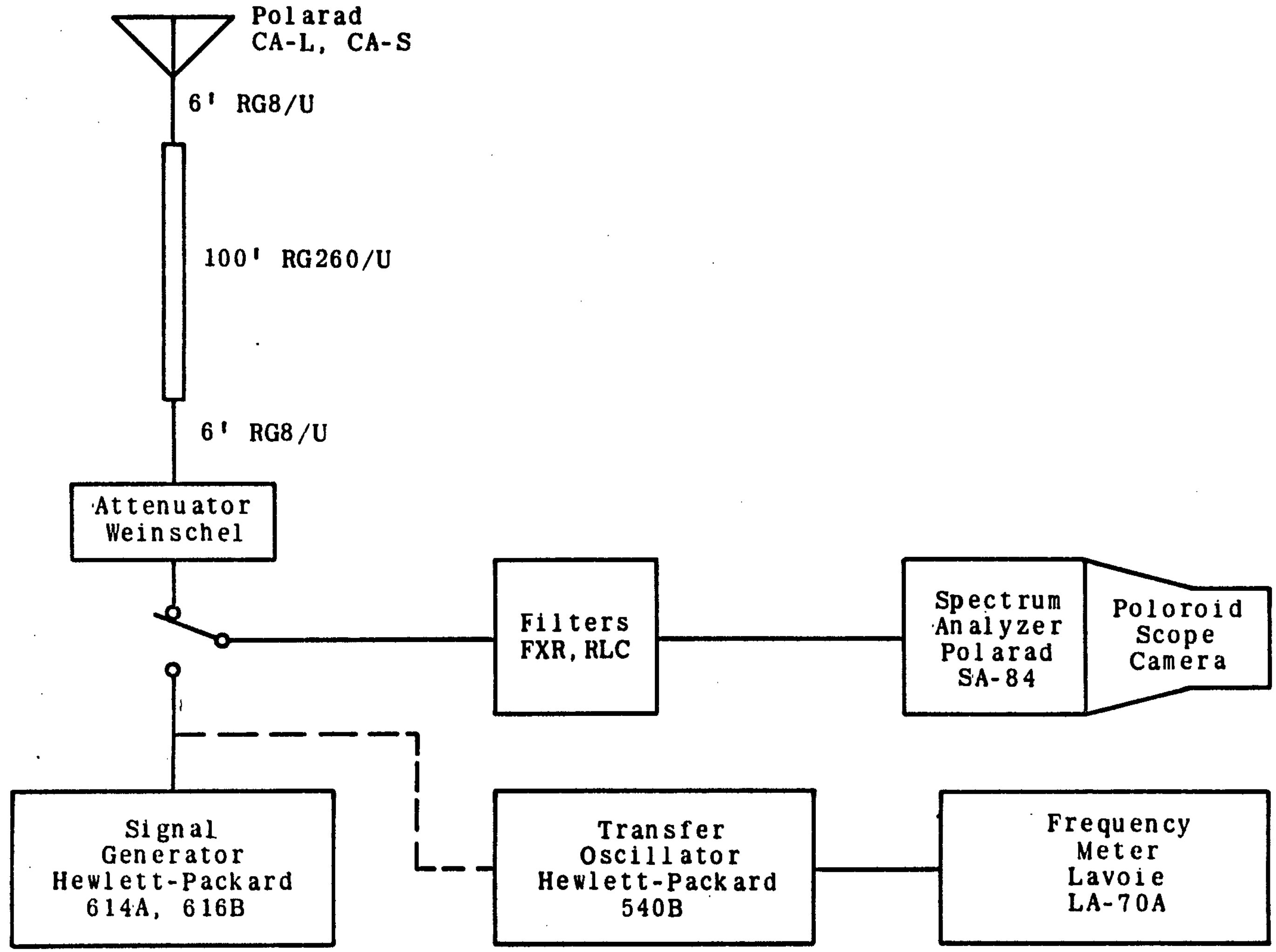
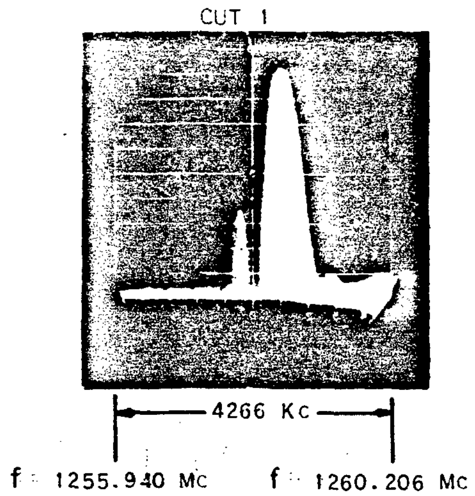
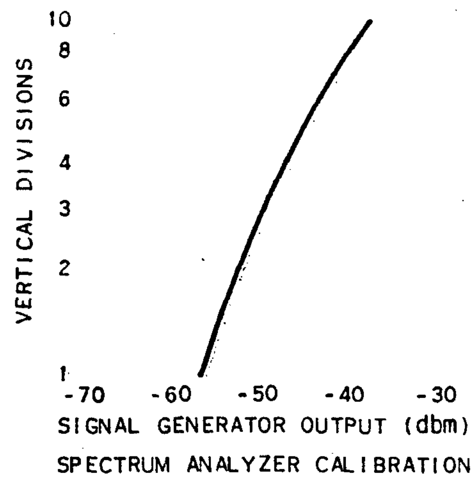
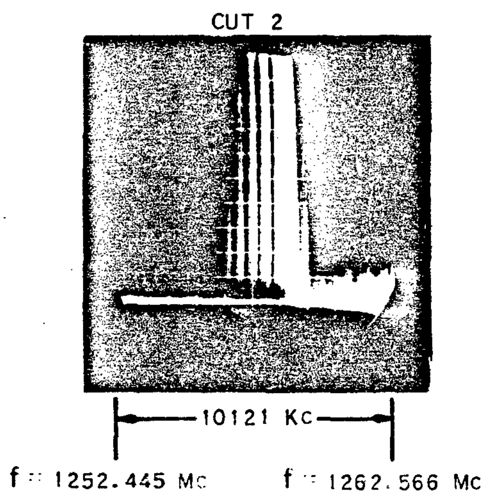


Figure 5.2.4-1. Emission Spectrum Test Block Diagram.







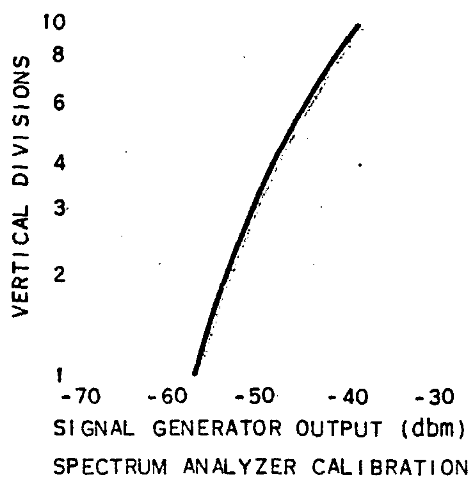


Figure 5.2.4-2. Emission Spectrum Photographs (f_o = 1257.8 Mc).

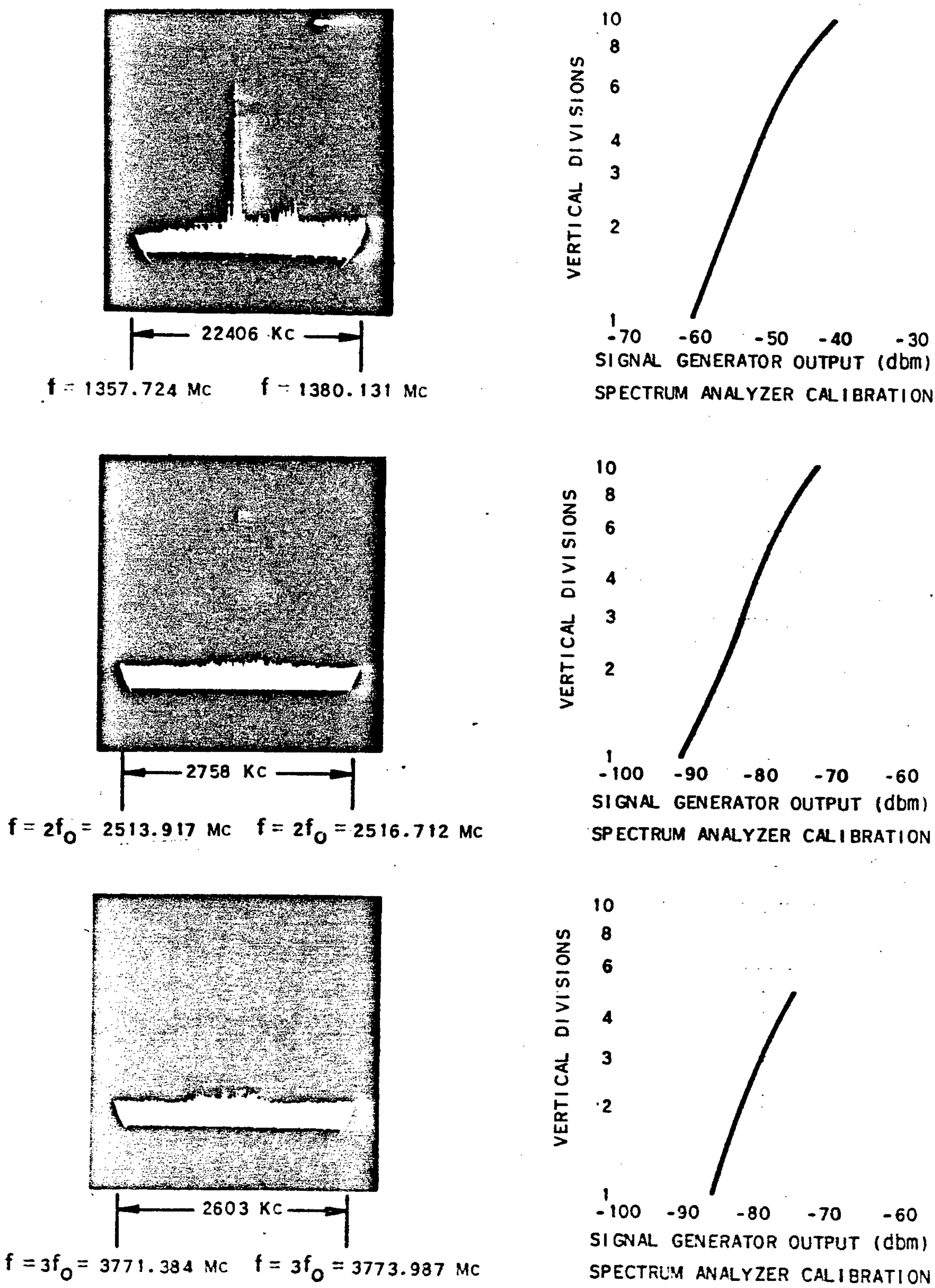
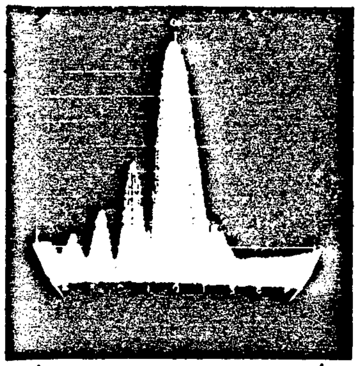


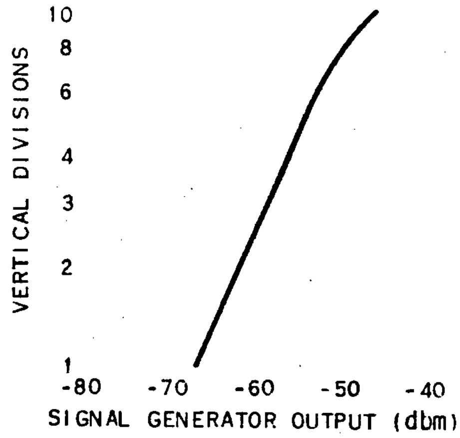
Figure 5.2.4-3. Emission Spectrum Photographs (f_o = 1257.8 Mc).

CUT 1



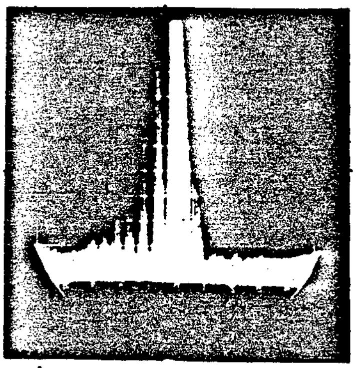
4666 Kc

f = f_o = 1295.198 Mc f = f_o = 1299.864 Mc



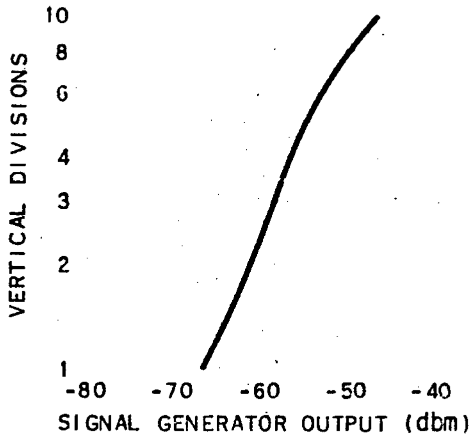
SPECTRUM ANALYZER CALIBRATION

CUT 2



10055 Kc

f = f_o = 1292.518 Mc f = f_o = 1302.573 Mc



SPECTRUM ANALYZER CALIBRATION

Figure 5.2.4-4. Emission Spectrum Photographs (f_o = 1297.8 Mc).

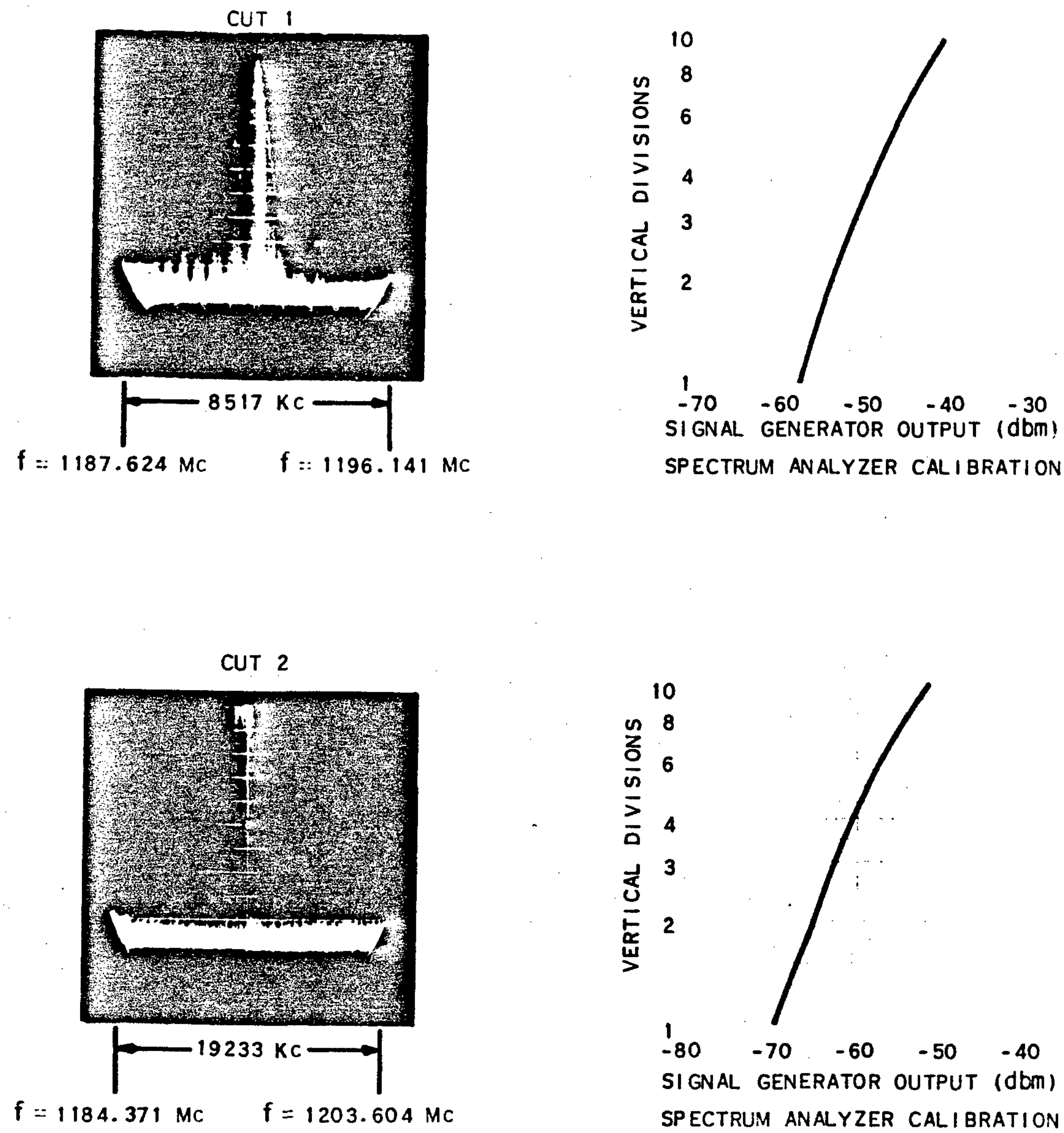
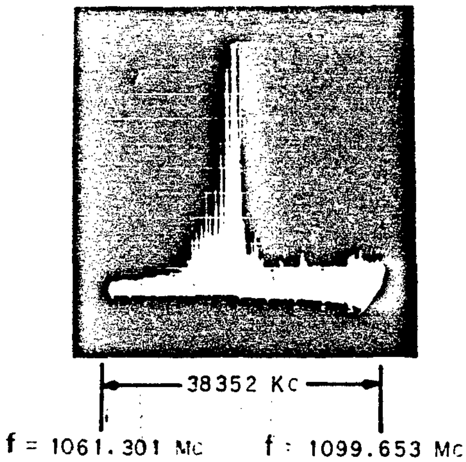
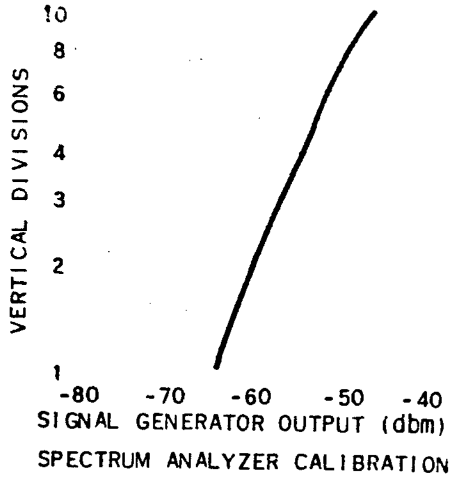
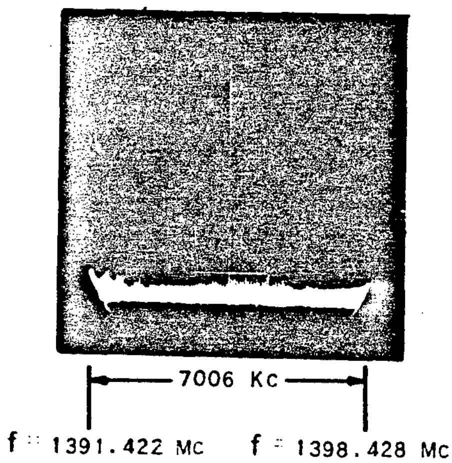


Figure 5.2.4-5. Emission Spectrum Photographs (f_o = 1297.8 Mc).







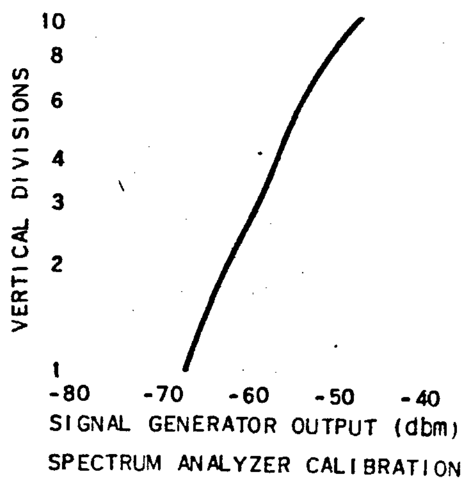
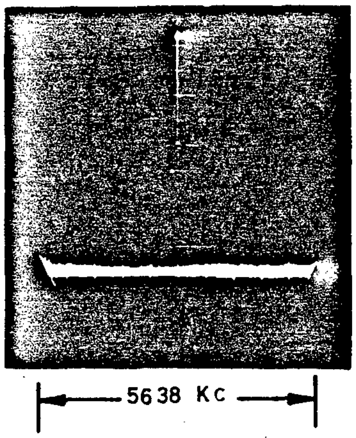
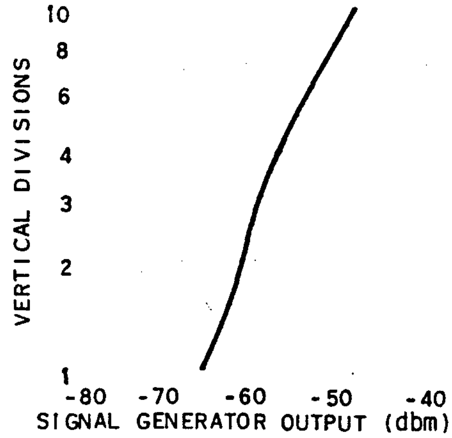


Figure 5.2.4-6. Emission Spectrum Photographs (f_0 = 1297.8 Mc).

CUT 1

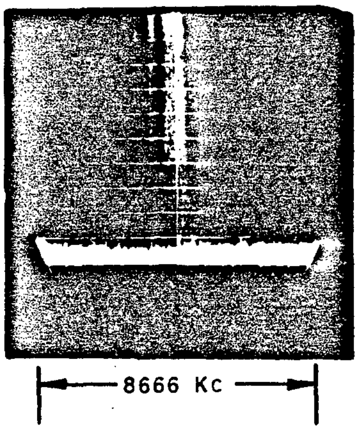


f = 1783.368 Mc   f = 1789.006 Mc

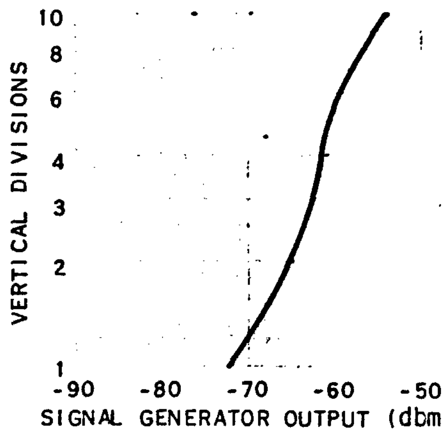


SPECTRUM ANALYZER CALIBRATION.

CUT 2

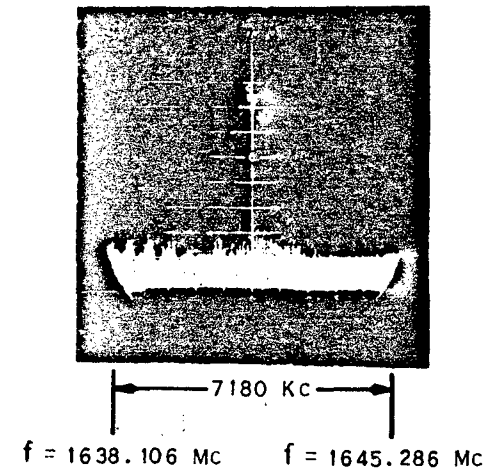


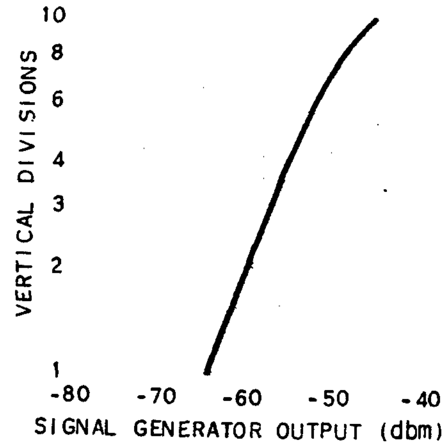
f = 1782.287 Mc   f = 1790.953 Mc



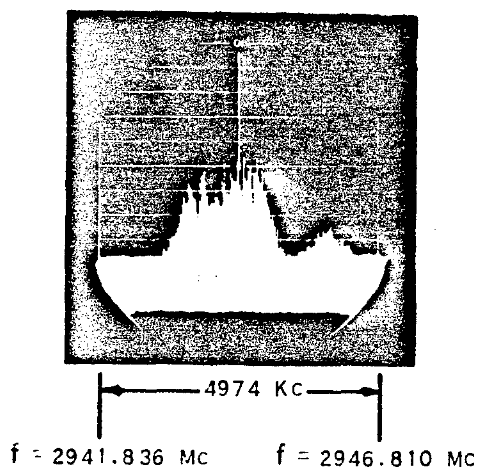
SPECTRUM ANALYZER CALIBRATION

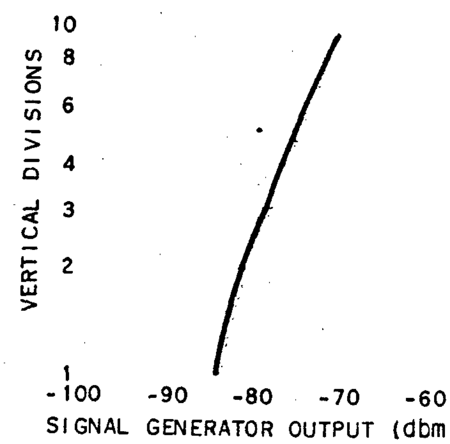
Figure 5.2.4-7. Emission Spectrum Photographs (f_0 = 1297.8 Mc).





SPECTRUM ANALYZER CALIBRATION





SPECTRUM ANALYZER CALIBRATION

Figure 5.2.4-8. Emission Spectrum Photographs (f_0 = 1297.8 Mc).

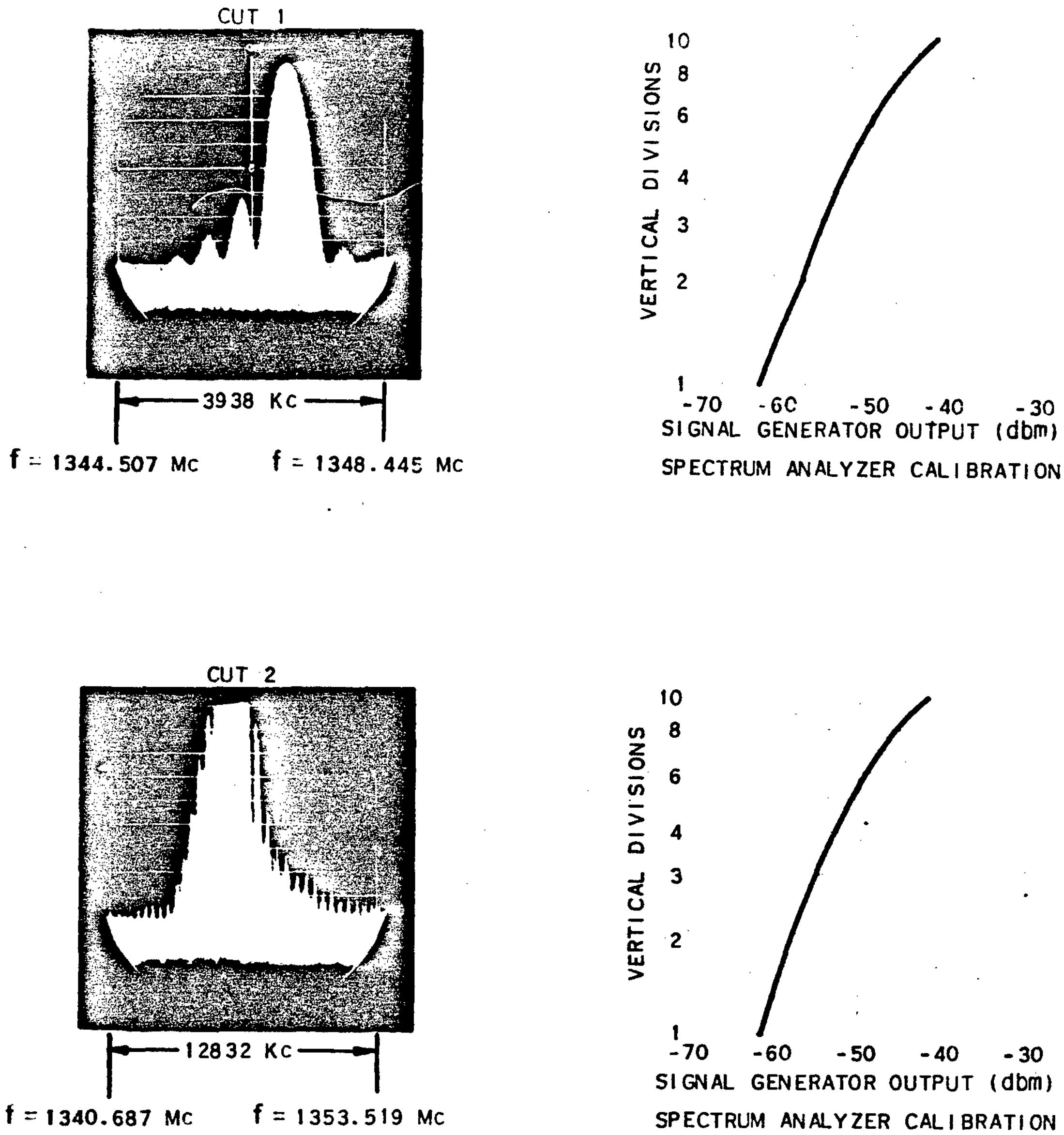
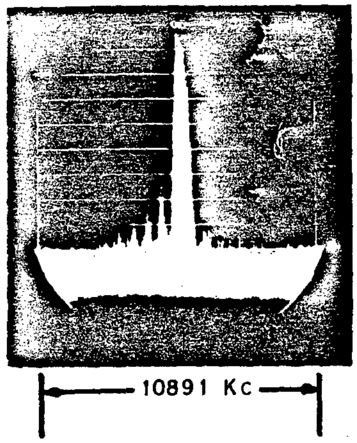
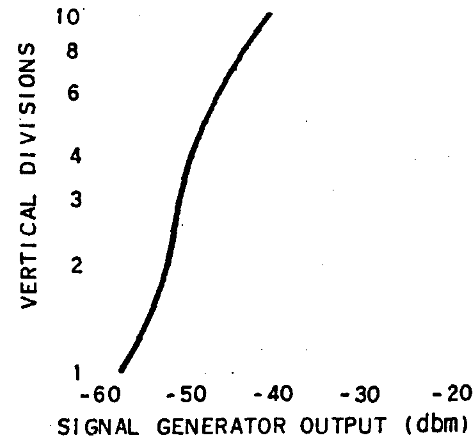


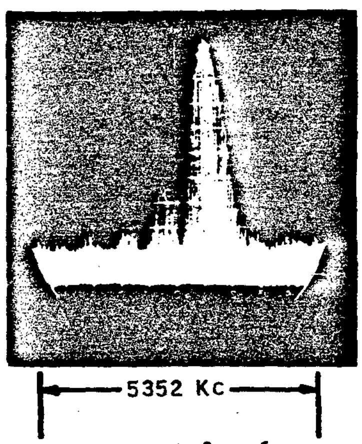
Figure 5.2.4-9. Emission Spectrum Photographs (f_o = 1348.2 Mc).



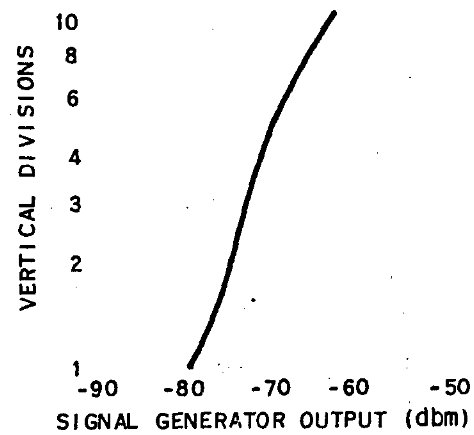
f = 1258.064 Mc f = 1268.955 Mc



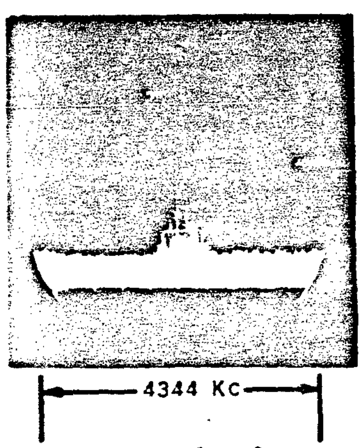
SPECTRUM ANALYZER CALIBRATION



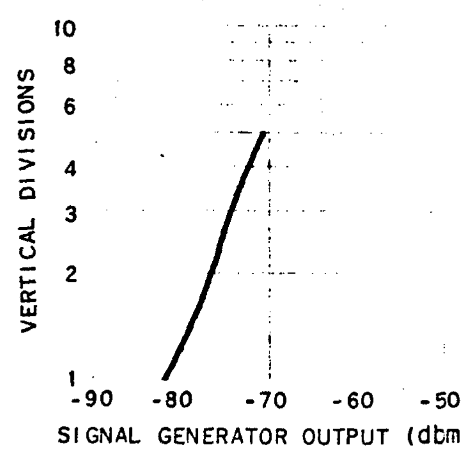
$f = 2f_o = 2691.257$ Mc $f = 2f_o = 2696.609$ Mc



SPECTRUM ANALYZER CALIBRATION



$f = 3f_o = 4039.248$ Mc $f = 3f_o = 4043.592$ Mc



SPECTRUM ANALYZER CALIBRATION

Figure 5.2.4-10. Emission Spectrum Photographs (f_o = 1348.2 Mc).

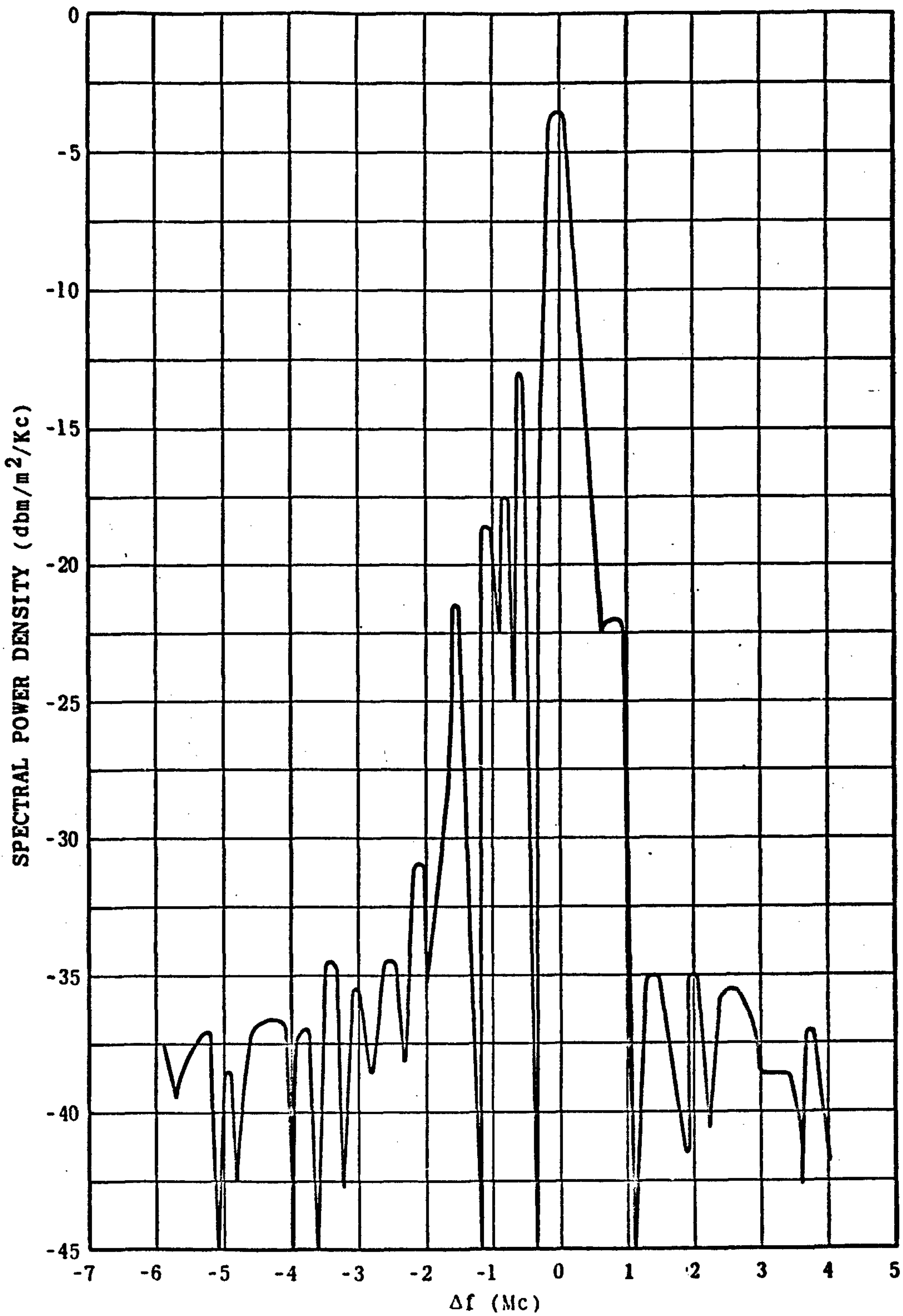


Figure 5.2.4-11. Emission Spectral Distribution
$f = 1257.8$ Mc ($f_o = 1257.8$ Mc).

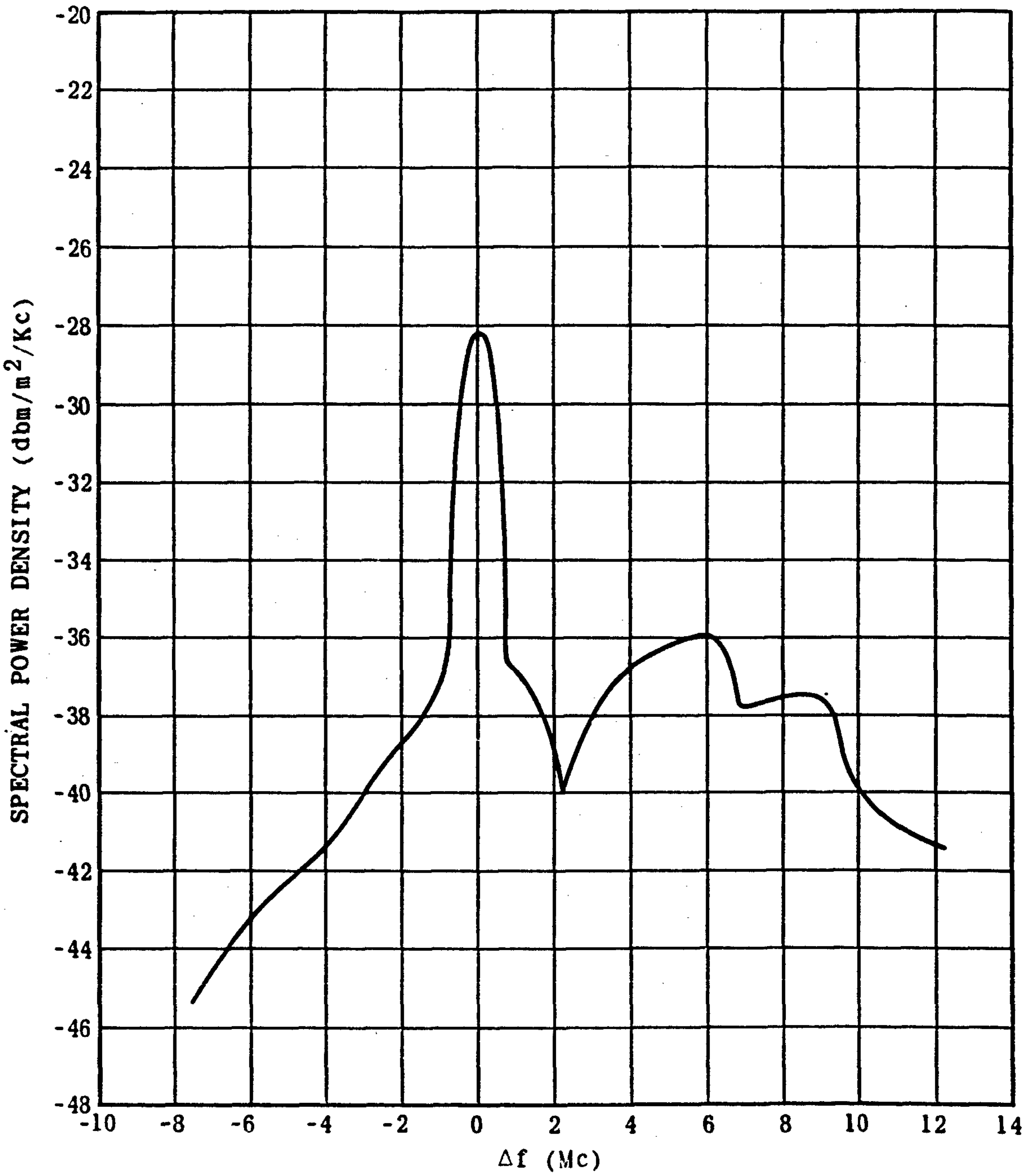


Figure 5.2.4-12. Emission Spectral Distribution
$f = 1367.8$ Mc ($f_o = 1257.8$ Mc).

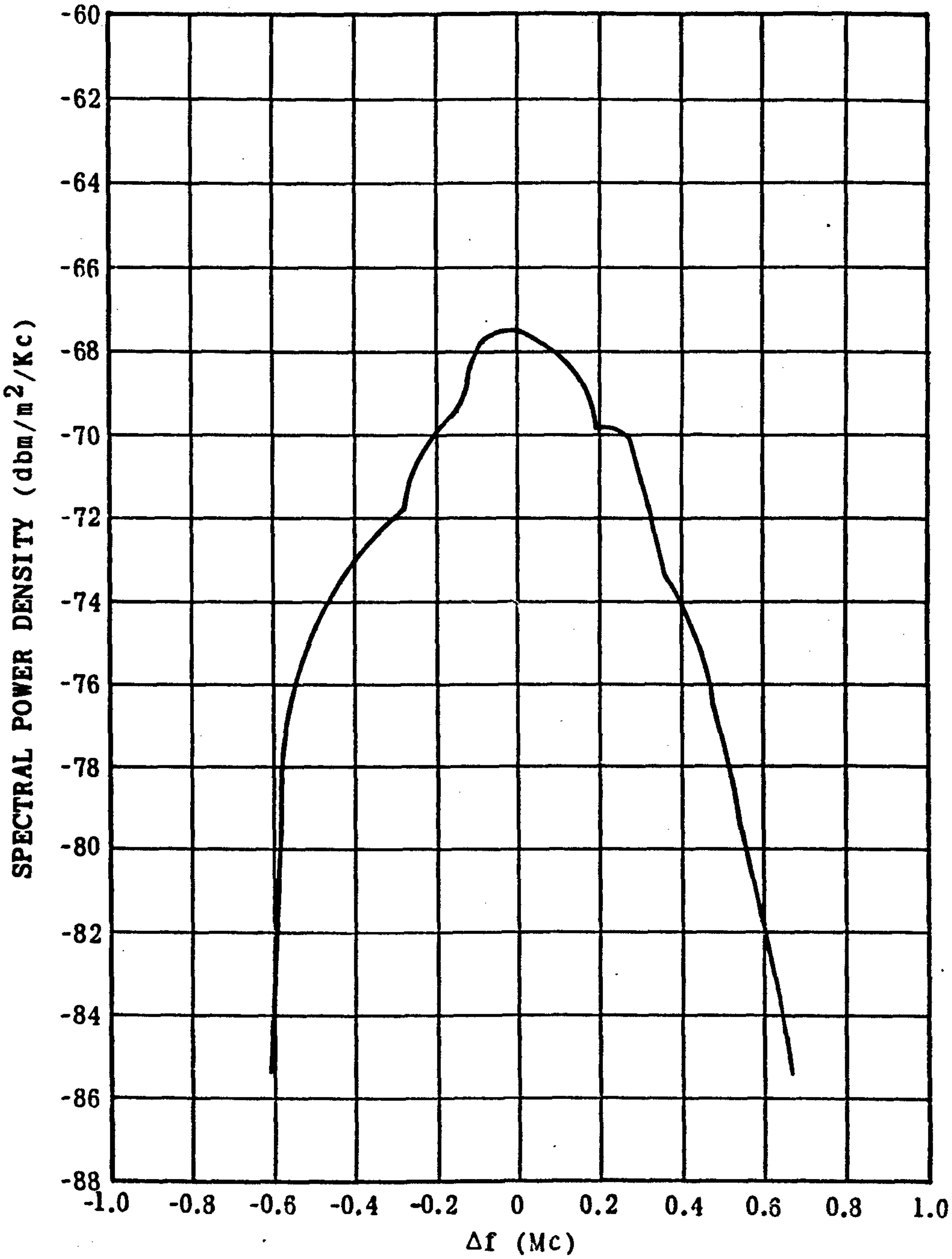


Figure 5.2.4-13. Emission Spectral Distribution
$f = 2f_o = 2515.3$ Mc ($f_o = 1257.3$ Mc).

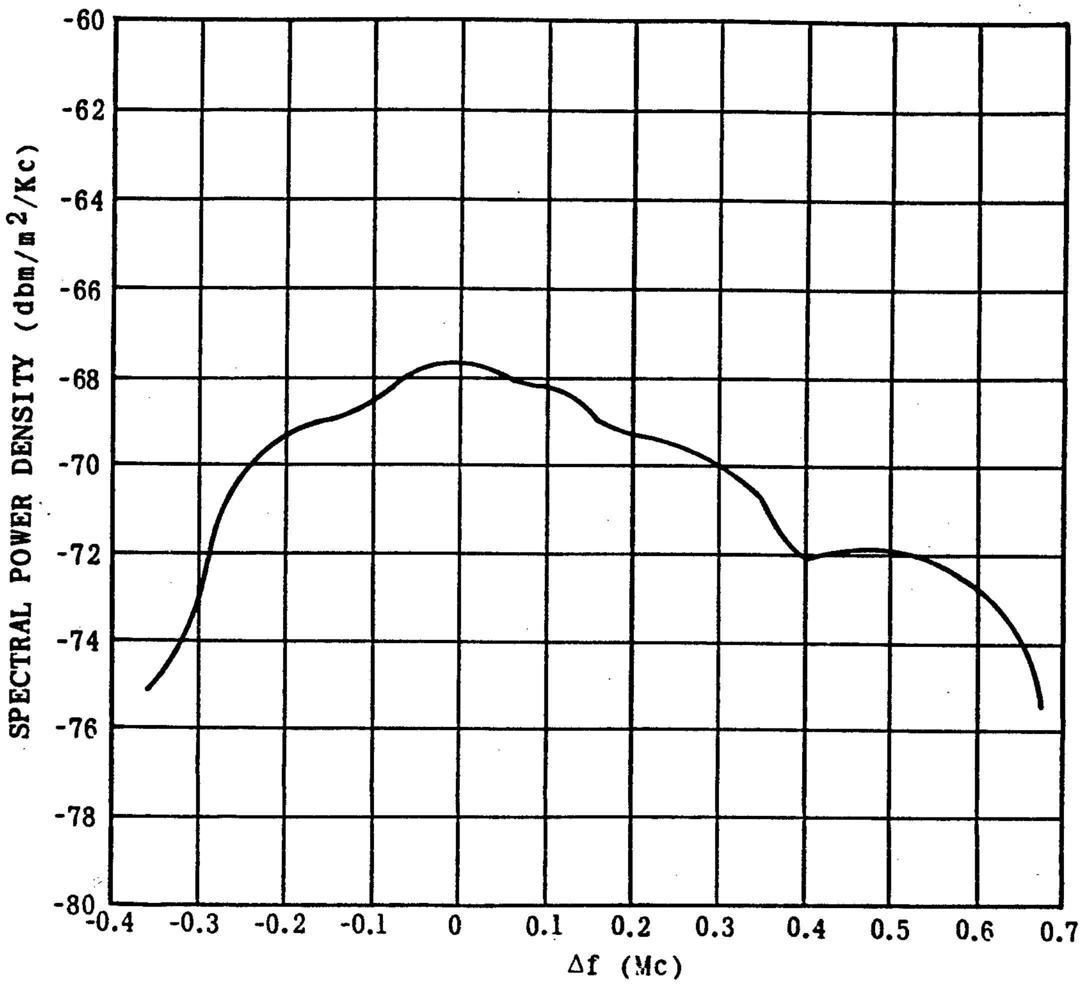


Figure 5.2.4-14. Emission Spectral Distribution
$f = 3fo = 3772.5$ Mc ($f_o = 1257.8$ Mc).

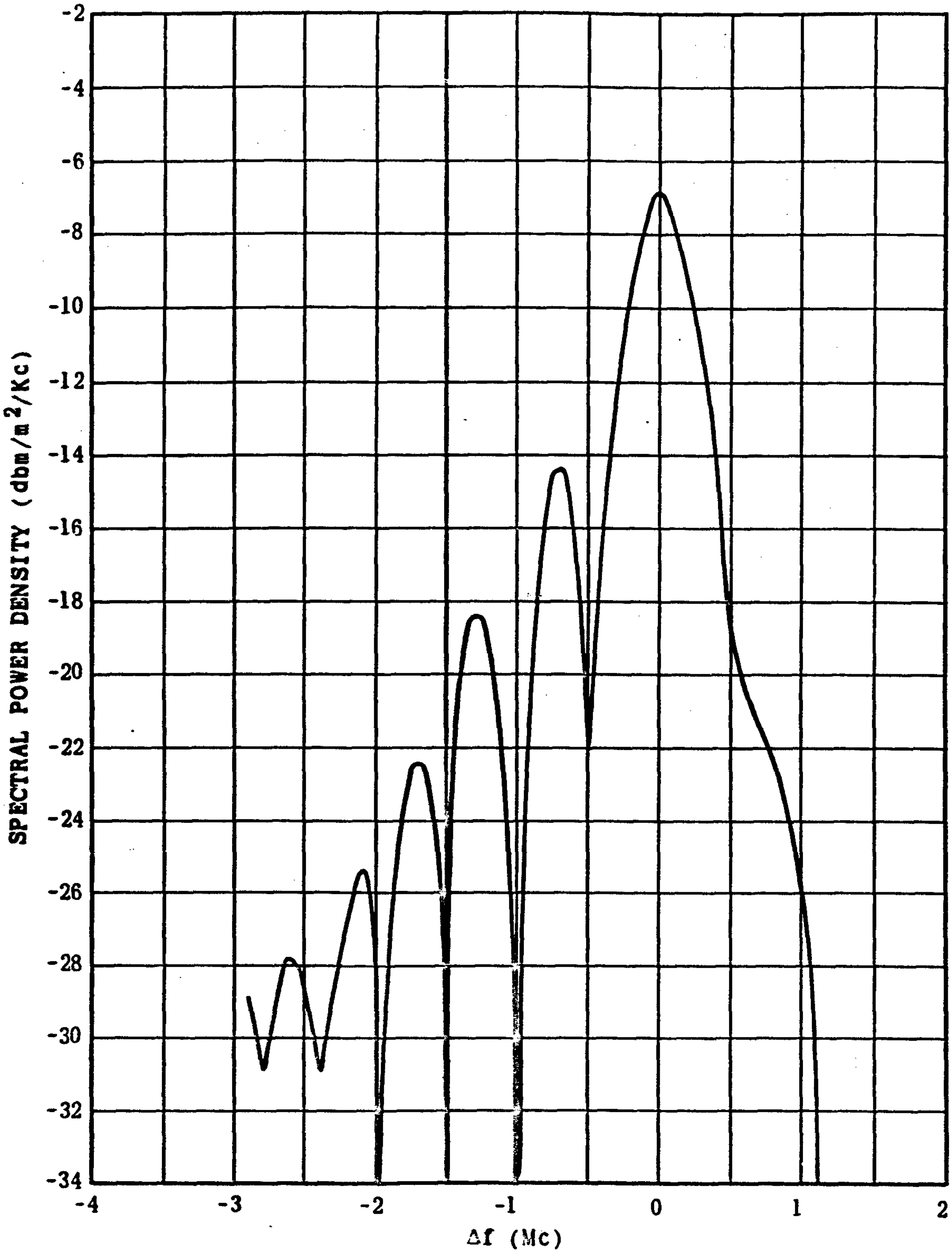


Figure 5.2.4-15. Emission Spectral Distribution
f = 1297.8 Mc (f_o = 1297.8 Mc).

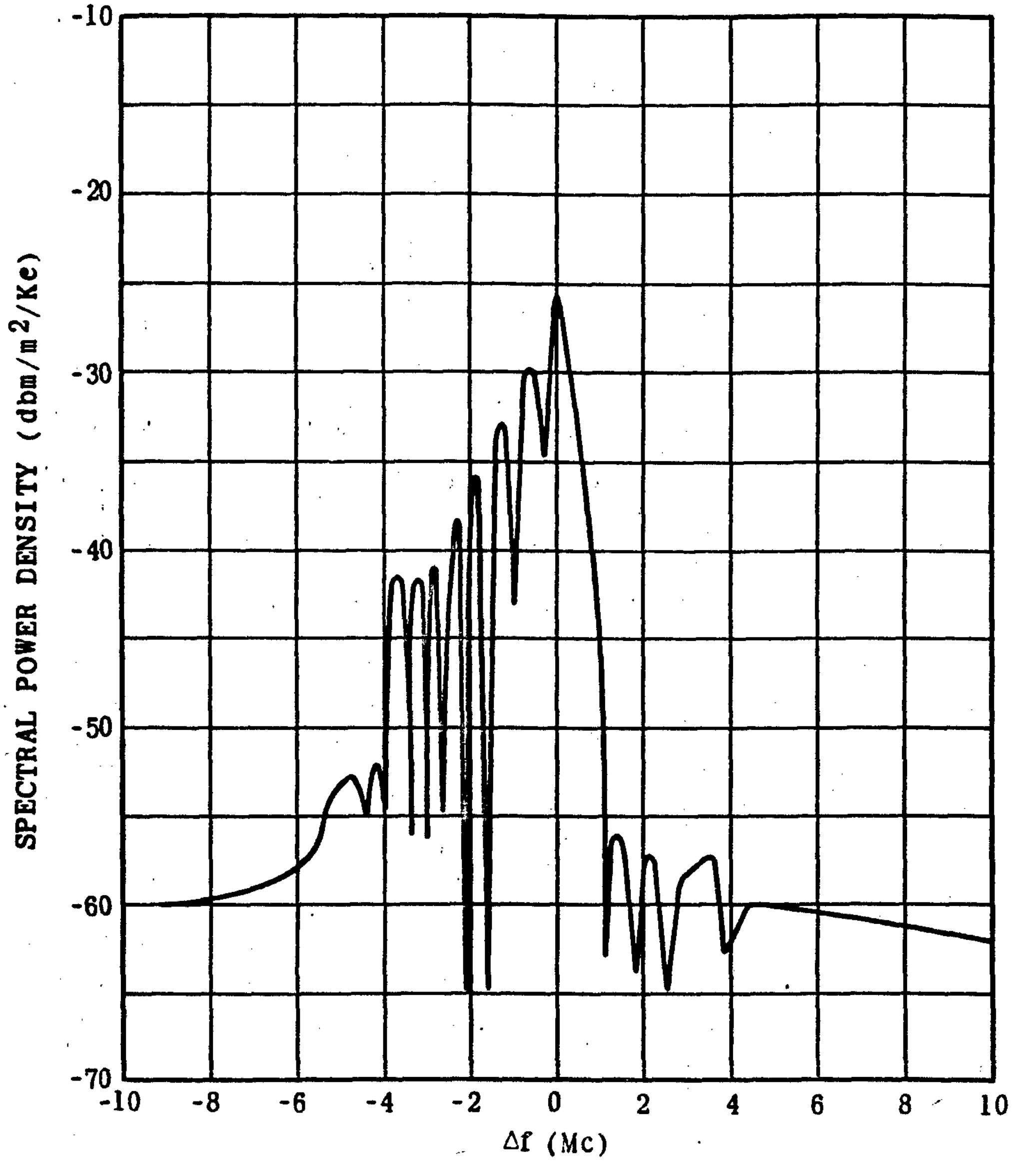


Figure 5.2.4-16. Emission Spectral Distribution
$f = 1191.9$ Mc ($f_o = 1297.8$ Mc).

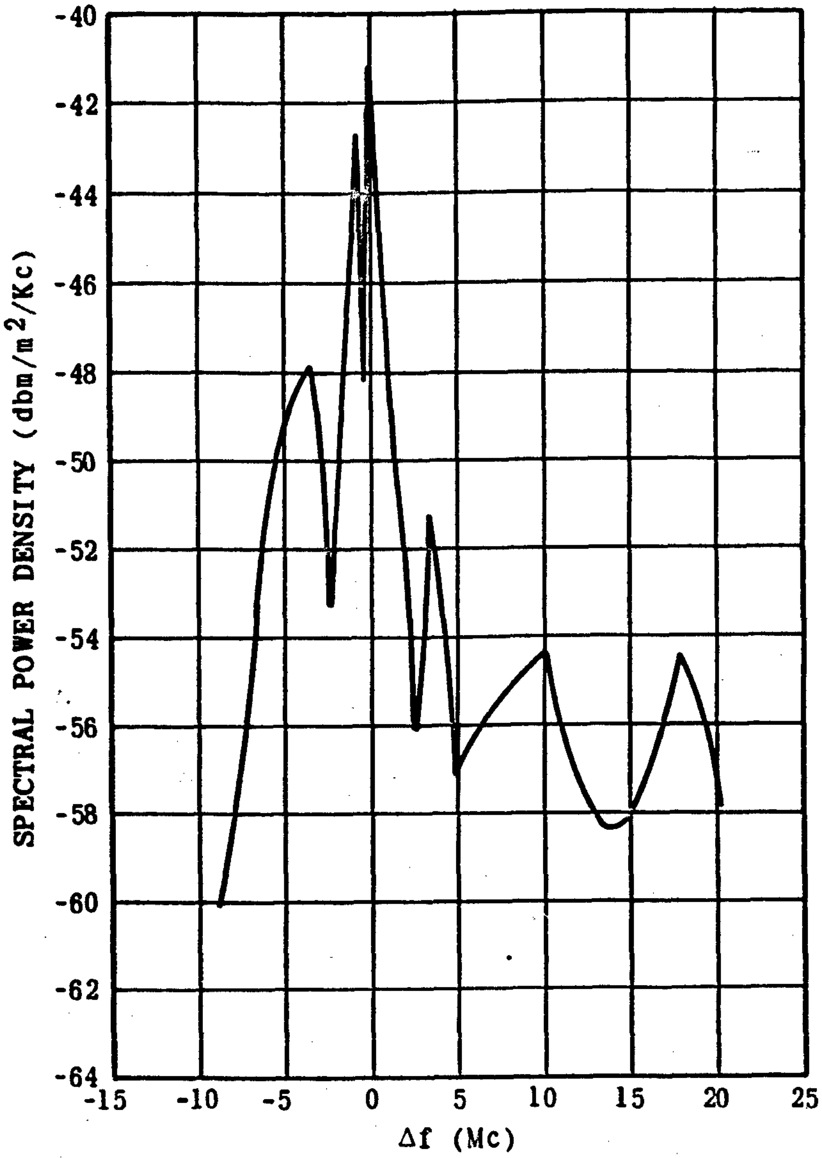


Figure 5.2.4-17. Emission Spectral Distribution
f = 1079.3 Mc (f_o = 1297.8 Mc).

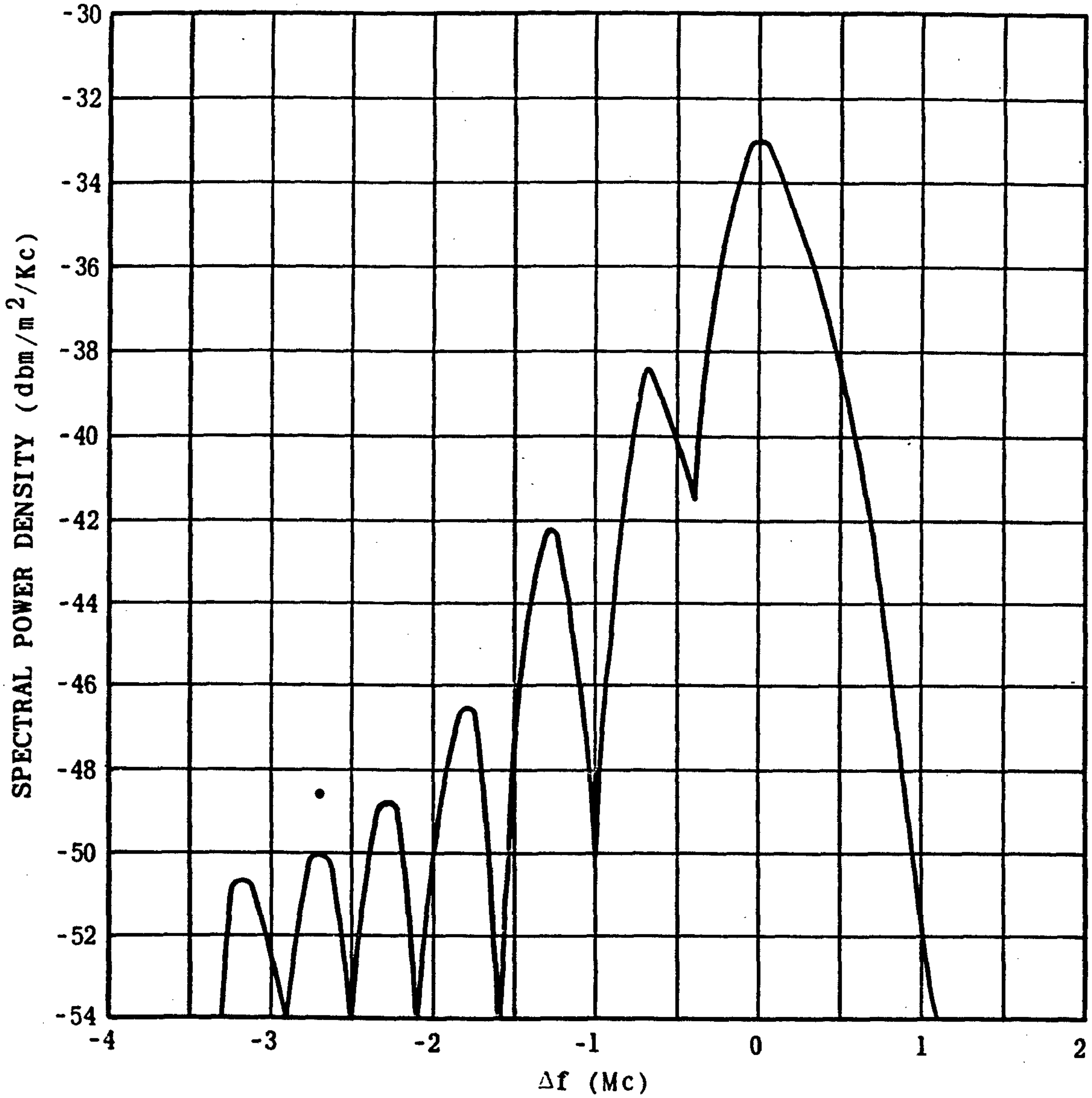


Figure 5.2.4-18. Emission Spectral Distribution
f = 1394.9 Mc (f_o = 1297.8 Mc).

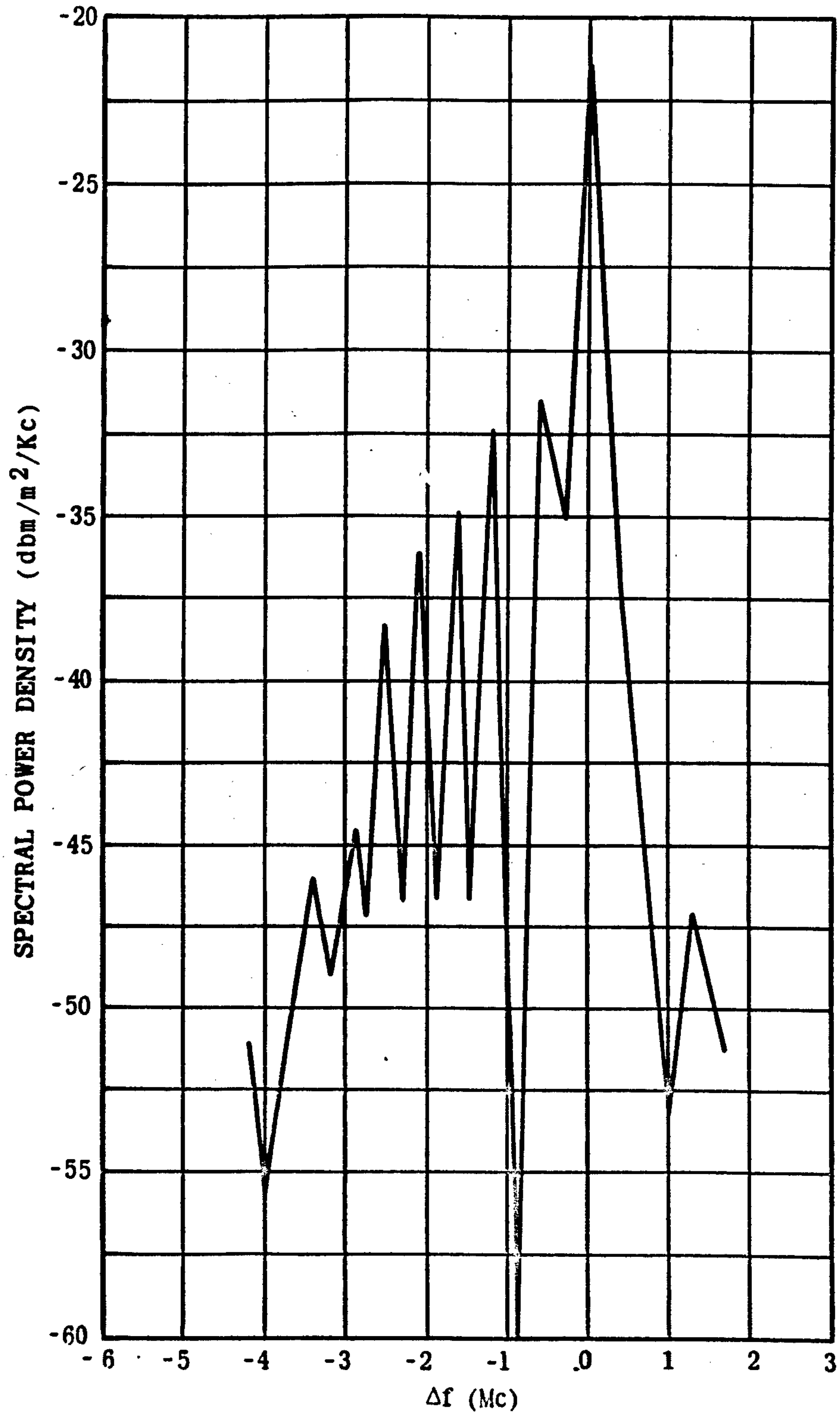


Figure 5.2.4-19. Emission Spectral Distribution
f = 1786.2 Mc (f_o = 1297.8 Mc).

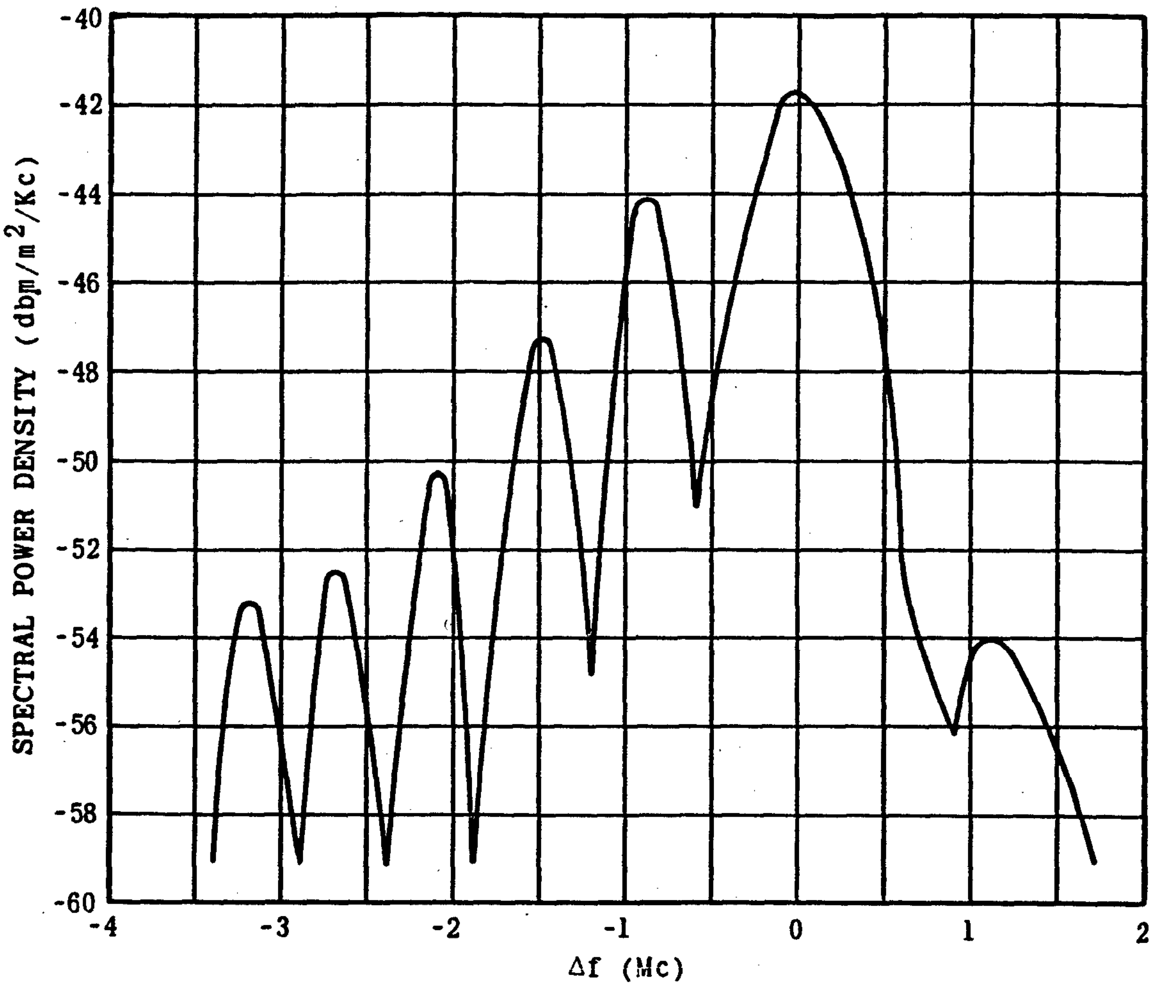


Figure 5.2.4-20. Emission Spectral Distribution
f = 1641.7 Mc (f_o = 1297.8 Mc).

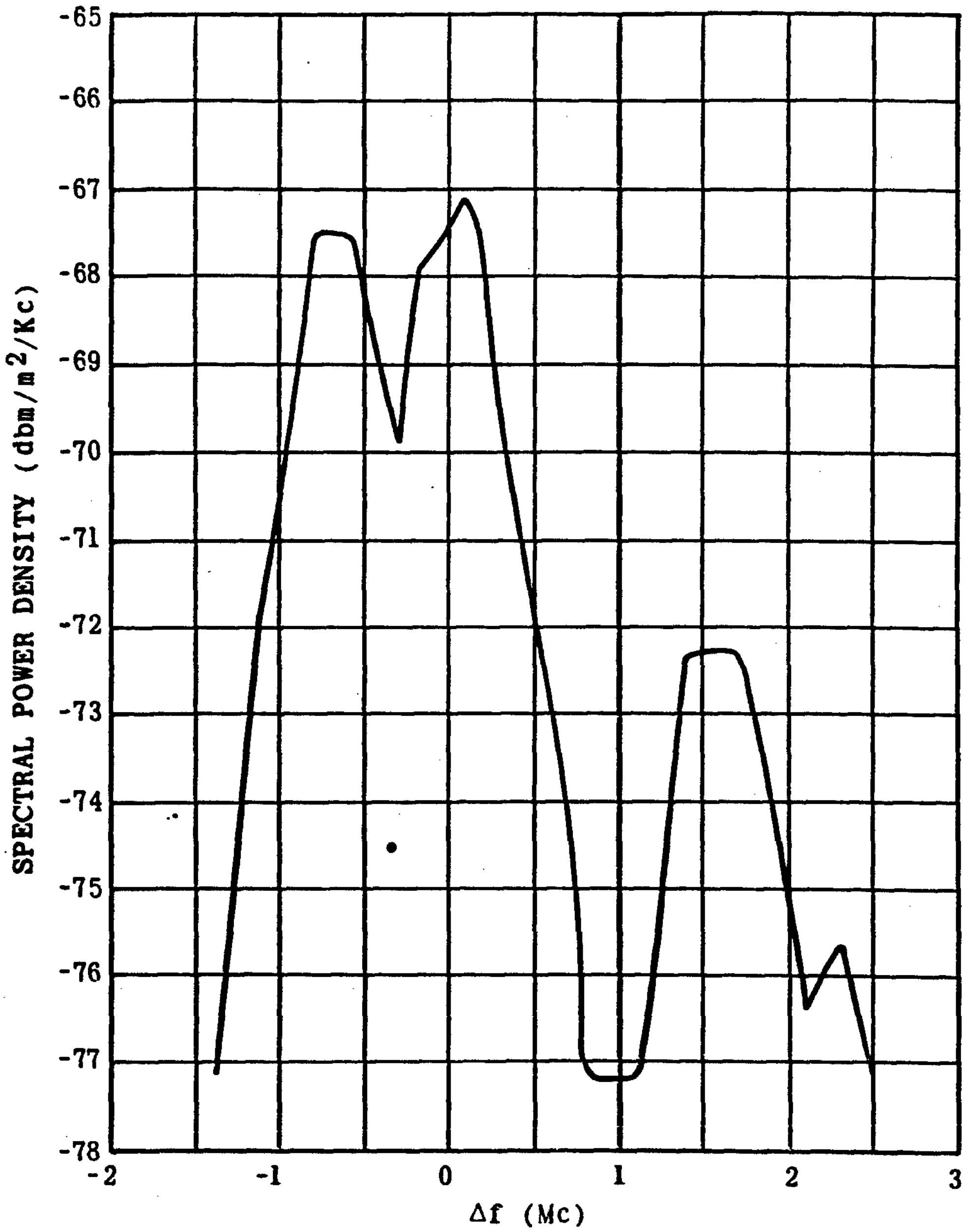


Figure 5.2.4-21. Emission Spectral Distribution
$f = 2944.3$ Mc ($f_o = 1297.8$ Mc).

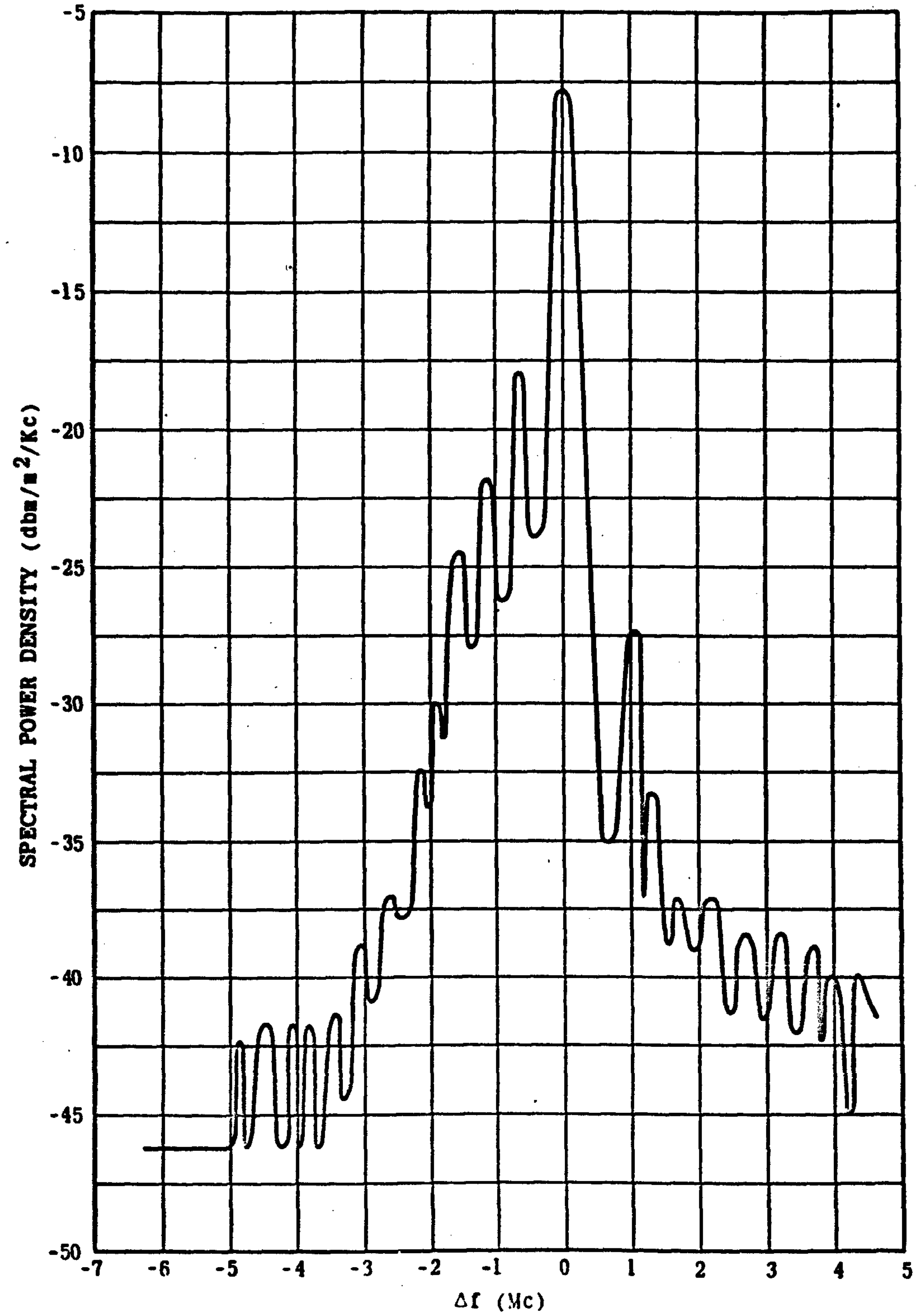


Figure 5.2.4-22. Emission Spectral Distribution
f = 1347.0 Mc (f_o = 1348.2 Mc).

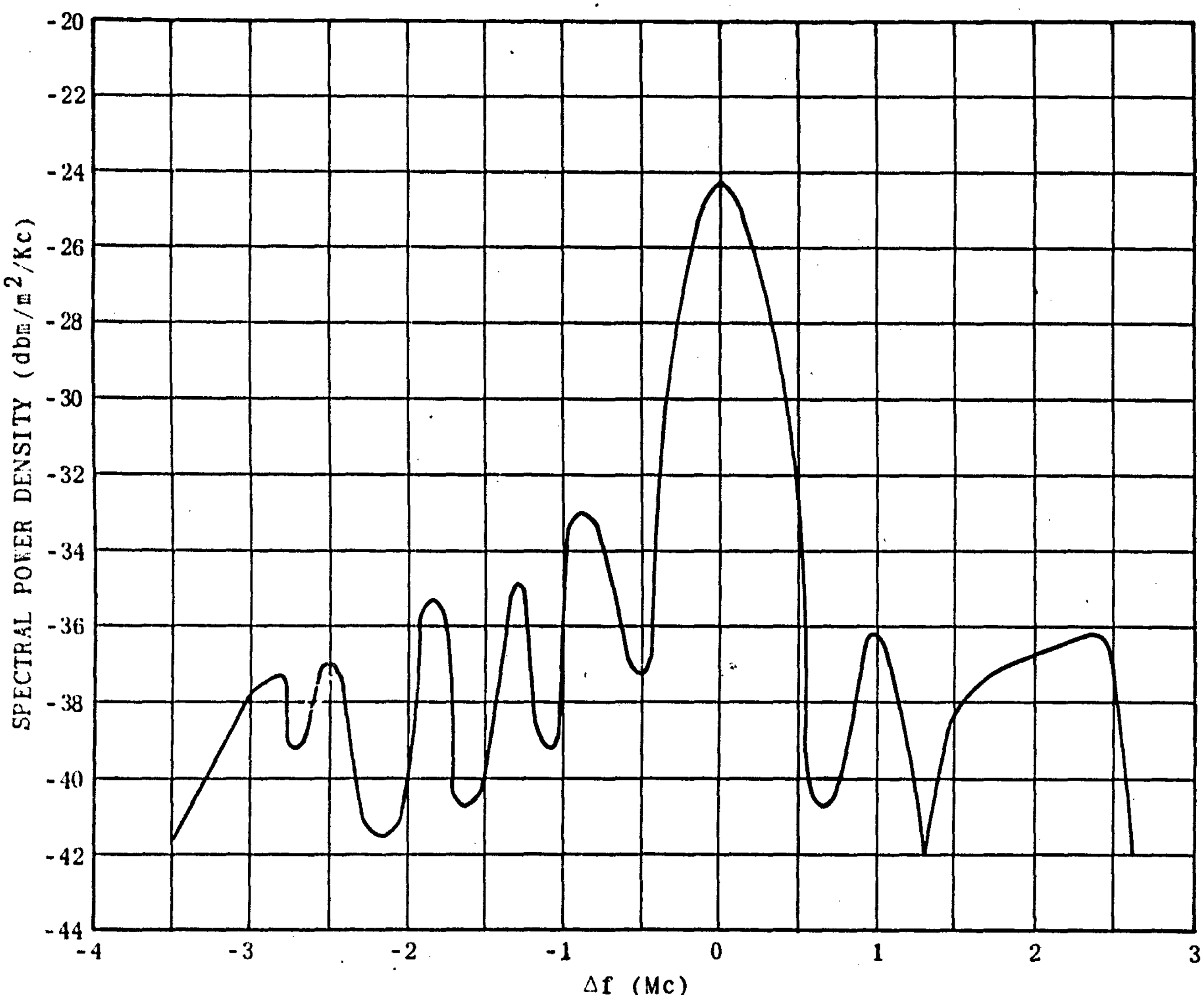


Figure 5.2.4-23. Emission Spectral Distribution $f = 1263.7$ Mc ($f_o = 1348.2$ Mc).

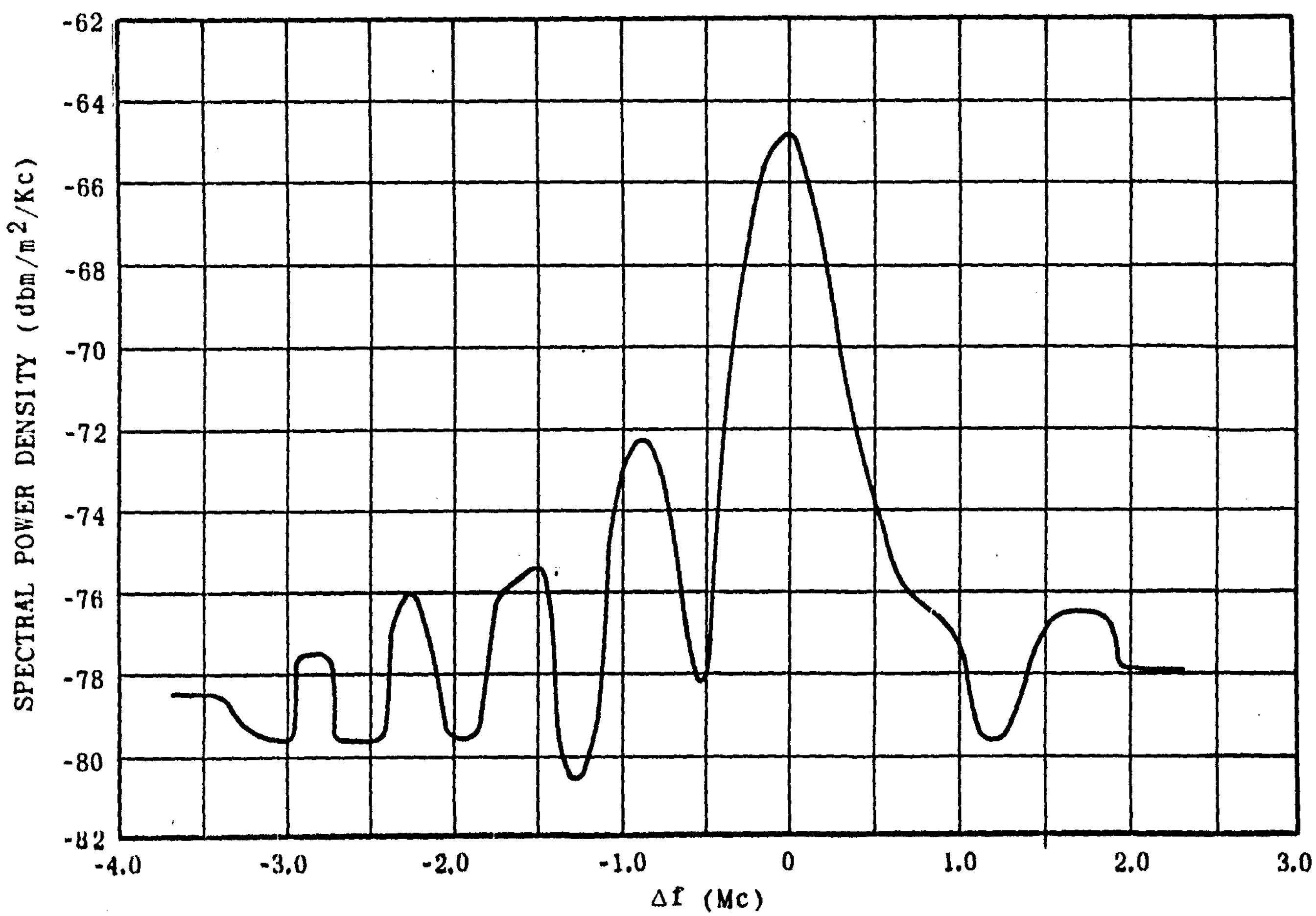


Figure 5.2.4-24. Emission Spectral Distribution
f = 2694.6 Mc (f_o = 1348.2 Mc).

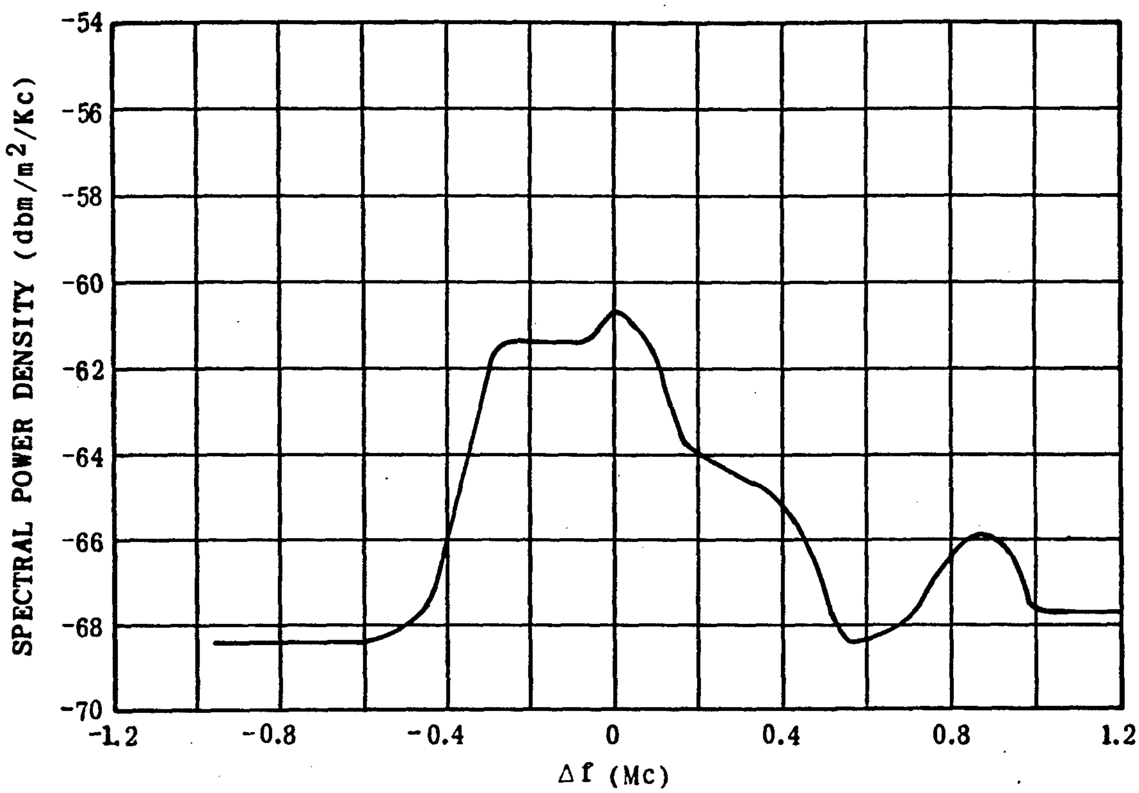


Figure 5.2.4-25. Emission Spectral Distribution
f = 4041.4 Mc (f_o = 1348.2 Mc).

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/13/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1543, 1601

Measuring Devices: Weinschel Attenuators Type 210, FXR & RLC Filters Polarad SA-84, HP 614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1257.8	1258.5	-5.9	-53	10	10	5.1	-37.5
		-5.7	-55				-39.5
		-5.5	-53				-37.5
		-5.2	-52.5				-37.0
		-5.1					
		-5.0	-54				-38.5
		-4.8	-58				-42.5
		-4.6	-52.5				-37.0
		-4.1	-52.0				-36.5
		-4.0					
		-3.8	-52.5				-37.0
		-3.6					
		-3.4	-50				-34.5
		-3.2	-57				-42.5
		-3.0	-51				-35.5
		-2.8	-54				-38.5
		-2.5	-50				-34.5
		-2.3	-53.5				-38
		-2.1	-46.5				-31
		-2.0	-50.5				-35
		-1.7	-44				-23.5
		-1.6	-57		30		-21.5
		-1.4	-40		10		-24.5

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/13/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1543, 1601

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP 614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1257.8	1258.5	-1.2		10	10	5.1	
		-1.1	-54		30		-18.5
		-.9	-38		10		-22.5
		-.8	-53		30		-17.5
		-.7	-38		10		-22.5
		-.6	-48.5		30		-13.0
		-.5	-53		30		-17.5
		-.4			10		
		-.3	-50		30		-14.5
		-.2	-42.5		30		-7.0
		0	-39		30		-3.5
		.2	-42.5		30		-7.0
		.40	-50		30		-14.5
		.6	-38		10		-22.5
		.8	-57.5		30		-22.0
		.9	-57.5		30		-22.0
		1.0	-43.5		10		-28.0
		1.1					
		1.2	-54.5		10		-39.0
		1.4	-50.5		10		-35.0
		1.7	-54		10		-38.5
		1.9	-57		10		-41.5
↓	↓	2.0	-50.5	↓	10	↓	-35.0

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/13/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1543, 1601

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters, Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf ($\pm$Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m^2)
1257.8	1258.5	2.2	-56	10.0	10	5.1	-40.5
		2.5	-51				-35.5
		2.9	-52.5				-37.0
		3.0	-54				-38.5
		3.4	-54				-38.5
		3.6	-57				-42.5
		3.7	-52.5				-37.0
		-4.0	-57				-41.5

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT
EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/13/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1617

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf ($\pm$Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1257.8	1367.8	-7.4	-61.0	10.6	10.0	5.4	-45.1
		-5.6	-58.5				-42.6
		-3.4	-56.5				-40.6
		-2.9	-55.5				-39.6
		-1.1	-53.4				-37.5
		-0.7	-51.5				-35.6
		0.0	-44.0				-28.1
		0.7	-52.5				-36.5
		1.1	-53.0				-37.0
		2.2	-56.0				-40.5
		3.8	-52.8				-36.8
		5.6	-51.9				-35.9
		6.3	-52.1				-36.1
		6.9	-53.8				-37.8
		9.0	-53.5				-37.5
		10.0	-56.0				-40.0
		12.3	-57.6				-41.6

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

©

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A, 5110.11 Date: 12/14/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1847

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-616B, HP-540B, Lavoie LA-70A, Polarad CA-S

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Atten-uation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1257.8	2515.3	-.61	-92.5	16.8	0	7.5	-85.4
		-.58	-86.4				-79.3
		-.55	-83.3				-76.2
		-.50	-81.7				-74.6
		-.41	-80.4				-73.3
		-.28	-78.8				-71.7
		-.28	-77.4				-70.3
		-.17	-76.7				-69.6
		-.14	-76.3				-69.2
		-.11	-75.0				-67.9
		0	-74.7				-67.6
		.17	-76.3				-69.2
		.19	-77.0				-69.9
		.25	-76.9				-69.8
		.28	-77.4				-70.3
		.30	-78.0				-70.9
		.33	-78.8				-71.7
		.36	-80.4				-73.3
		.44	-81.7				-74.6
		.47	-83.3				-76.2
		.55	-86.4				-79.3
		.66	-92.5				-85.4

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/14/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100' RG-260/U 6' RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization, (Horizontal), Transmitter B, Time 1900

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-616B, HP-540B, Lavoie LA-70A, Polarad CA-S

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1257.8	3772.5	-.36	-86.0	19.3	0	10.3	-75.1
		-.29	-83.0				-72.1
		-.18	-83.5				-72.6
		-.10	-79.3				-68.4
		-.05	-78.7				-67.8
		0	-78.5				-67.6
		.05	-78.9				-68.0
		.10	-79.0				-68.1
		.16	-80.0				-69.1
		.29	-80.5				-69.6
		.39	-83.0				-72.1
		.55	-83.0				-72.1
		.67	-86.0				-75.1

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/10/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B. Time 1750, 1800

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1297.8	1297.5	-2.9	-64.5	10.2	30	5.2	-28.9
		-2.8	-66.5				-30.9
		-2.6	-63.5				-27.9
		-2.4	-66.5				-30.9
		-2.1	-66.0		35		-25.4
		-2.0	null				
		-1.7	-63.0				-22.4
		-1.5	null				
		-1.3	-59.0				-18.4
		-1.0	null				
		-0.7	-55.0				-14.4
		-0.5	-62.5				-21.9
		0.0	-47.5				-6.9
		0.7	-61.8				-21.2
		1.0	-66.5				-25.9

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/10/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization, (Horizontal), Transmitter B, Time 1535

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1297.8	1079.3	-8.8	-64.8	8.8	0	4.5	-60.1
		-7.3	-60.0				-55.3
		-5.4	-54.3				-49.6
		-3.5	-52.5				-47.8
		-2.3	-57.8				-53.1
		-1.9	-54.3				-49.6
		-1.2	-51.0				-46.3
		-0.8	-47.5				-42.7
		-0.4	-53.0				-48.2
		0	-46.0				-41.2
		1.2	-53.2				-43.4
		1.9	-55.8				-51.0
		2.7	-60.8				-56.0
		3.5	-56.0				-51.2
		5.0	-61.8	8.9			-57.0
		10.4	-59.2				-54.4
		13.4	-63.0				-58.2
		15.0	-63.0				-58.2
		18.0	-59.2				-54.4
		20.3	-62.5				-57.7

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT
EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/10/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U, 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal), Transmitter B, Time 1845, 1910

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1297.8	1191.9	-9.2	-65.2	9.6	0	4.9	-60.0
		-5.8	-62.7				-57.5
		-5.4	-59.8				-54.6
		-4.8	-57.9				-52.7
		-4.4	-60.0				-54.8
		-4.2	-57.2				-52.0
		-3.9	-59.8				-54.6
		-3.7	-56.8		10		-41.6
		-3.4	-61.2		0		-56.0
		-3.2	-56.8		10		-41.6
		-3.0	-61.5		0		-56.3
		-2.8	-56.2		10		-41.0
		-2.6	-59.9		0		-54.7
		-2.3	-53.5		10		-33.3
		-2.1	-70.0		0		-64.8
		-1.9	-51.0		10		-35.8
		-1.6	-70.0		0		-64.8
		-1.3	-48.0		10		-32.8
		-1.0	-58.1				-42.9
		-0.6	-45.0				-29.8
		-0.3	-50.0				-34.8
		0.0	-41.0				-25.8
		0.9	-58.1				-42.9

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/10/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100' RG-260/U 6' RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization, (Horizontal), Transmitter B, Time 1845, 1910

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters, Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1297.8	1191.9	1.1	-68.0	9.6	0	4.9	-62.8
↓	↓	1.4	-61.5	↓	↓	↓	-56.3
		1.8	-68.8				-63.6
		2.1	-62.4				-57.2
		2.5	-70.0				-64.8
		2.9	-64.0				-58.2
		3.5	-62.5				-57.3
		3.8	-68.0				-62.8
		4.4	-65.2				-60.0
		10.0	-67.2				-62.0

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/10/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1925

Measuring Devices: Weinschel Attenuators Type 210, RXL&RLC Filters Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1297.8	1394.9	-3.3	null	10.8	10.0	5.5	
		-3.2	-66.8				-50.8
		-2.9	null				
		-2.7	-66.1				-50.1
		-2.5	null				
		-2.3	-64.8				-48.8
		-2.1	null				
		-1.8	-62.5				-46.5
		-1.6	null				
		-1.3	-58.2				-42.2
		-1.0	-66.1				-50.1
		-0.7	-54.4				-38.4
		-0.4	-57.5				-41.5
		0.0	-49.0				-33.0
		0.6	-56.7				-40.7
		1.0	-67.6				-51.6
		-1.1	null				

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT
EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/10/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization, (Horizontal), Transmitter B, Time 1940

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-614, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1297.8	1641.7	-3.4	-65.8	12.0	0	6.0	-59.1
		-3.2	-59.9				-53.2
		-2.9	-65.8				-59.1
		-2.7	-59.2				-52.5
		-2.4	-65.8				-59.1
		-2.1	-57.0				-50.3
		-1.9	-65.8				-59.1
		-1.5	-54.0				-47.3
		-1.2	-61.5				-54.8
		-0.9	-50.8				-44.1
		-0.6	-57.7				-51.0
		0.0	-48.5				-41.8
		0.3	-50.8				-44.1
		0.7	-60.8				-54.1
		0.9	-62.8				-56.1
		1.1	-60.8				-54.1
		1.7	-65.8				-59.1

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/10/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B. Time 2010, 2018

Measuring Devices: Weinschel Attenuators Type 210; FXR&RLC Filters Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1297.8	1786.2	-4.2	-68	12.6	10	6.1	-51.1
		-4.0	-72.5				-55.6
		-3.4	-62.9				-46.0
		-3.2	-65.8				-48.9
		-2.9	-61.5				-44.6
		-2.8	-64.0				-47.1
		-2.5	-65.2		20		-38.3
		-2.3	-63.5		10		-46.6
		-2.1	-63.0		20		-36.1
		-1.9	-63.5		10		-46.6
		-1.6	-61.7		20		-34.8
		-1.5	-63.5		10		-46.6
		-1.2	-59.2		20		-32.3
		-0.9	null		20		
		-0.6	-55.9		20		-29.0
		-0.3	-62.0		20		-35.1
		0	-48.3		20		-21.4
		0.4	-56.0		10		-39.1
		1.0	-72.5		10		-55.6
		1.3	-64.0		10		-47.1
		1.7	-68.0		10		-51.1

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/11/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1350

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-616B, HP-540B, Lavoie LA-70A, Polarad CA-S

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1297.8	2944.3	-1.4	-85.3	17.8	0	8.2	-77.1
		-1.1	-80.0				-71.8
		-0.8	-75.7				-67.5
		-0.6	-75.7				-67.5
		-0.3	-78.0				-69.8
		-0.2	-76.1				-67.9
		0	-75.7				-67.5
		0.1	-75.3				-67.1
		0.5	-77.3				-69.1
		0.7	-82.3				-74.1
		0.8	-85.3				-77.1
		1.1	-85.3				-77.1
		1.3	-82.3				-74.1
		1.4	-80.5				-72.3
		1.7	-80.5				-72.3
		1.9	-83.3				-74.1
		2.1	-84.5				-76.3
		2.3	-83.8				-75.6
		2.5	-85.3				-77.1

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

JAB FORM 5572-3

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/15/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1448, 1500

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1348.2	1347.0	-6.27	-61.9	10.8	10.0	5.5	-46.2
		-4.98	-61.9				-46.2
		-4.86	-58.0				-42.3
		-4.73	-61.9				-46.2
		-4.48	-57.4				-41.7
		-4.22	-61.9				-46.2
		-4.09	-57.4				-41.7
		-3.97	-61.9				-46.2
		-3.84	-57.4				-41.7
		-3.71	-61.9				-46.2
		-3.45	-57.0				-41.3
		-3.33	-60.1				-44.4
		-3.07	-54.5				-38.8
		-2.94	-56.6				-40.9
		-2.68	-52.8				-37.1
		-2.43	-53.5				-37.8
		-2.17	-48.1				-32.4
		-2.05	-49.6				-33.9
		-1.92	-45.6				-29.9
		-1.79	-47.0				-31.3
		-1.77	-63.7		30.0		-28.0
		-1.57	-60.2				-24.5
		-1.33	-63.7				-28.0

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/15/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1448, 1500

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Atten-uation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1348.2	1347.0	-1.14	-57.5	10.8	30.0	5.5	-21.8
		-.91	-62.0				-26.3
		-.67	-53.6				-17.9
		-.43	-59.6				-23.9
		0	-43.5				-7.8
		.64	-50.8		10.0		-35.1
		1.03	-43.0				-27.3
		1.16	-52.8				-37.1
		1.28	-49.0				-33.3
		1.53	-54.5				-38.8
		1.66	-52.9				-37.2
		1.92	-54.7				-39.0
		2.17	-52.9				-37.2
		2.43	-57.0				-41.3
		2.69	-54.1				-38.4
		2.94	-57.3				-41.6
		3.20	-54.1				-38.4
		3.45	-57.7				-42.0
		3.71	-54.6				-38.9
		3.84	-58.0				-42.3
		3.98	-55.7				-40.0
		4.22	-60.7				-45.0
		4.35	-55.7				-40.0

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/15/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100' RG-260/U 6' RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1535

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-614A, HP-540B, Lavoie LA-70A, Polarad CA-L

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1348.2	1263.7	-3.49	-57.9	10.0	10.0	5.9	-41.6
		-2.83	-53.6				-37.3
		-2.72	-55.5				-39.2
		-2.51	-53.3				-37.0
		-2.18	-57.9				-41.6
		-1.85	-51.6				-35.3
		-1.63	-57.0				-40.7
		-1.31	-51.1				-34.8
		-1.09	-55.5				-39.2
		-0.87	-49.2				-32.9
		-0.50	-53.5				-37.2
		0.00	-40.5				-24.2
		0.65	-57.0				-40.7
		0.98	-52.5				-36.2
		1.31	Null				Null
		1.53	-54.3				-38.0
		1.74	-53.5				-37.2
		2.40	-53.2				-36.9
		2.62	Null				Null

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/15/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100' RG-260/U
6' RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1830

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-616B, HP-540B, Lavoie LA-70A, Polarad CA-S

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1348.2	2694.6	-3.32	-86.2	17.3	0	7.8	-78.6
		-3.00	-87.2				-79.6
		-2.89	-85.1				-77.5
		-2.78	-85.1				-77.5
		-2.68	-87.2				-79.6
		-2.46	-87.2				-79.6
		-2.36	-84.3				-76.7
		-2.25	-83.6				-76.0
		-2.14	-85.1				-77.5
		-1.98	-87.2				-79.6
		-1.83	-86.6				-79.0
		-1.71	-83.6				-76.0
		-1.50	-83.0				-75.4
		-1.39	-84.9				-78.3
		-1.23	-87.2				-79.6
		-1.07	-83.0				-75.4
		-0.86	-79.8				-72.2
		-0.54	-85.8				-78.2
		-0.43	-81.6				-74.0
		-0.11	-73.2				-65.6
		0	-72.4				-64.8
		0.32	-73.1				-70.5
		0.64	-83.2				-75.6

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/15/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1830

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-616B, HP-540B, Lavoie LA-70A, Polarad CA-S

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf ($\pm$Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1348.2	2694.6	0.96	-84.6	17.3	0	7.8	-77.0
↓	↓	1.18	-87.2	↓	↓	↓	-79.6
		1.60	-84.1				-76.5
		1.82	-84.1				-76.5
		1.93	-85.4				-77.8

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

JAB FORM 3572-3

TRANSMITTER MEASUREMENT

EMISSION SPECTRUM

Photographs are required.

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/15/62

Xmtr. Serial No.: 54 BW of Measuring Instrument: 20 kc

Tuning Band (Mc): 1240-1350 Cable Type & Length: 100'RG-260/U 6'RG-8/U

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal) Transmitter B, Time 1838

Measuring Devices: Weinschel Attenuators Type 210, FXR&RLC Filters Polarad SA-84, HP-616B, HP-540B, Lavoie LA-70A, Polarad CA-S

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Xmtr. Tuned Freq. (Mc)	Freq. Analyzed (Mc)	Δf (±Mc)	Signal Gen. Output (dbm)	Test Ant. Gain (db)	Attenuation Inserted (db)	Cable Losses (db)	Spectral Power Density (dbm/kc/m²)
1348.2	4041.4	-0.96	-80.0	19.9	0	10.9	-68.4
		-0.61	-80.0				-68.4
		-0.43	-78.8				-67.2
		-0.35	-75.6				-64.0
		-0.26	-73.0				-61.4
		-0.09	-73.0				-61.4
		0.00	-72.3				-60.7
		0.09	-73.2				-61.6
		0.17	-75.4				-63.8
		0.35	-76.3				-64.7
		0.56	-80.0				-68.4
		0.87	-77.5				-65.9
		1.04	-79.3				-67.7
		1.22	-79.3				-67.7

Measurement Instructions

For each transmitter standard test frequency take data to determine the received power density per kc of bandwidth for each transmitter spurious output. Take enough points Δf about the spurious output maximum to describe the envelope of the spurious output.

Use reverse side for block diagram and remarks.

5.2.5 Modulation Characteristics

The purpose of this test is to recover information on the amplitude versus time characteristics of system radiated output. Figure 5.2.5-1 is a block diagram of the setup for the modulation characteristics test. The receiver is tuned to the fundamental or spurious emission of the radar transmitter. The pulse envelope is recovered, displayed on the oscilloscope, and photographed. In order to permit a low distortion recovery of the pulse envelope, the 3 db bandwidth of the receiver should be at least 2/W, where W is the nominal pulse width. A bandwidth of at least 1 megacycle is then required for the 2 microsecond pulse of the ARSR radar. Two bandwidths are available in the Stoddart NM-62A. These bandwidths are 0.5 megacycle and 5.0 megacycles. All pulse envelopes were recovered with the bandwidth switch in the 5.0 megacycle position.

Fundamental frequency rejection filters were used wherever possible when recovering the pulse envelopes of spurious emissions above the radar fundamental.

Pulse envelopes of spurious emissions were obtained with the radar transmitter tuned to the three standard test frequencies. Photographs of these pulse envelopes are shown in Figures 5.2.5-2 through 5.2.5-6. Data are recorded on three (3) data sheets.

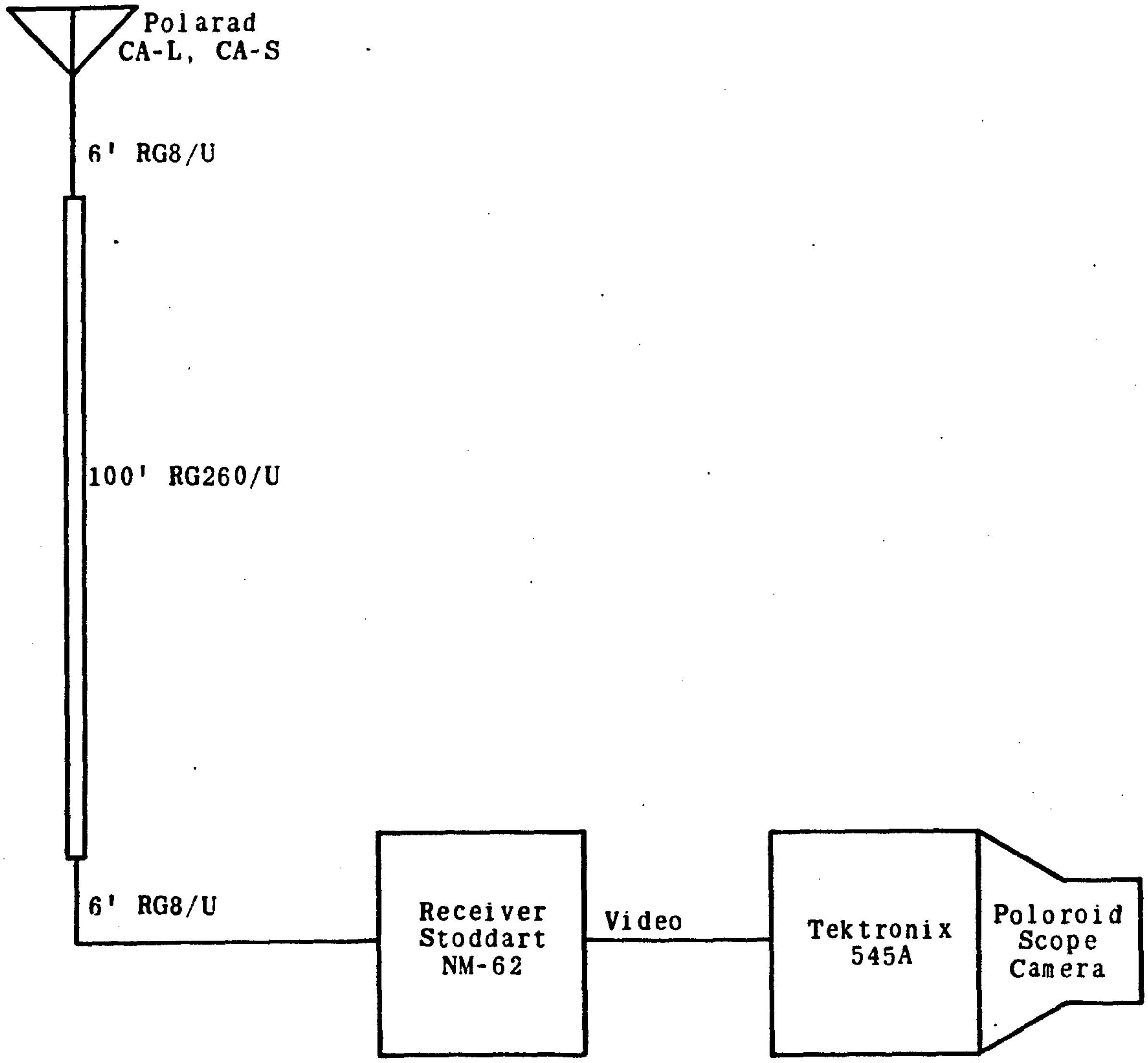


Figure 5.2.5-1. Modulation Characteristics Test Block Diagram.

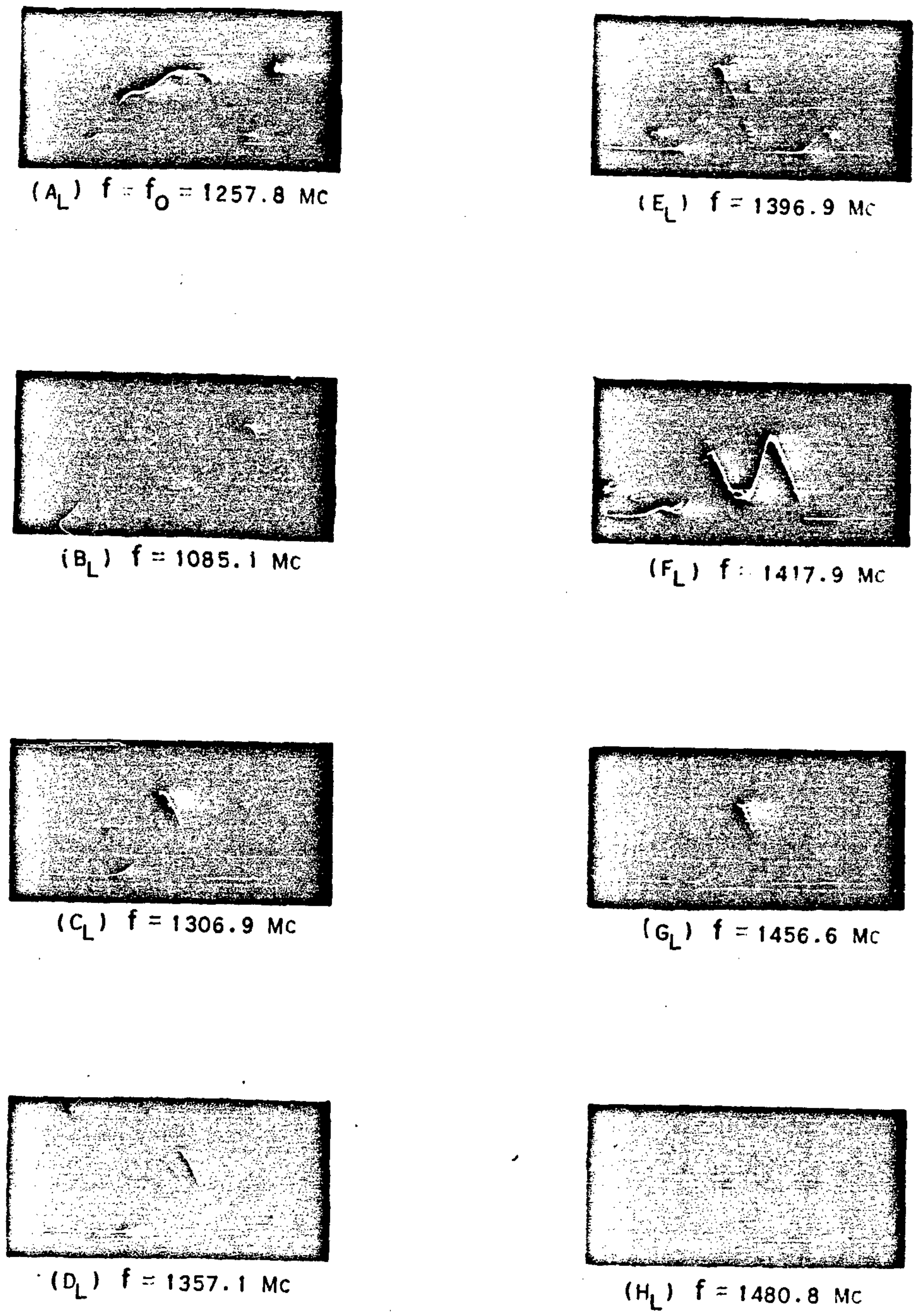
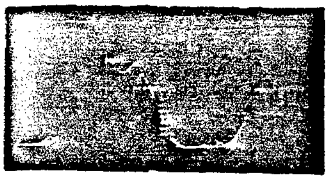
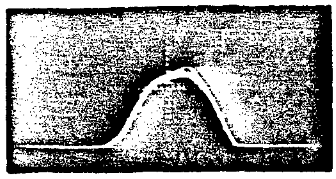


Figure 5.2.5-2. Modulation Characteristics Photographs (f_o = 1257.8 Mc).

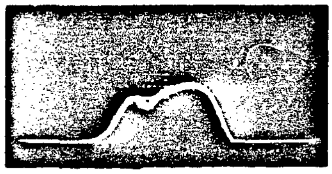


(I_L) f = 1669.4 Mc

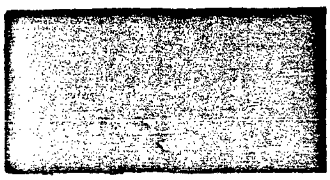


(L_L) $f = 2f_o$ = 2515.6 Mc

(J_L) f = 1790.3 Mc



(M_L) $f = 3f_o$ = 3773.4 Mc

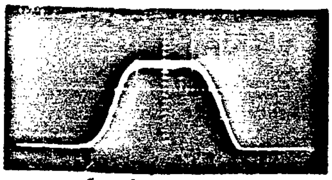


(K_L) f = 1898.7 Mc

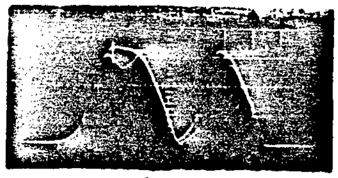
SWEEP TIME = 0.5 μs/CM

SWEEP LENGTH = 10.0 CM

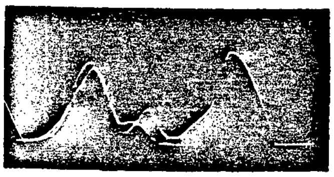
Figure 5.2.5-3. Modulation Characteristics Photographs (f_o = 1257.8 Mc).



(A_C) $f = f_o = 1297.8$ Mc



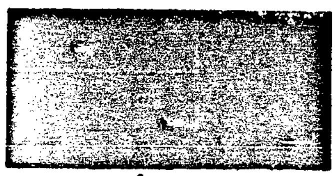
(D_C) $f = 1397$ Mc



(B_C) $f = 1085$ Mc

(E_C) $f = 1647$ Mc

(C_C) $f = 1197$ Mc



(F_C) $f = 1898$ Mc

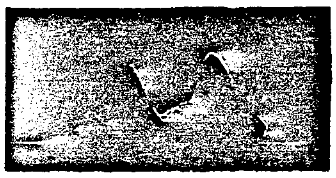
SWEEP TIME = 0.5 μs/CM

SWEEP LENGTH = 10.0 CM

Figure 5.2.5-4. Modulation Characteristics Photographs (f_o = 1297.8 Mc).

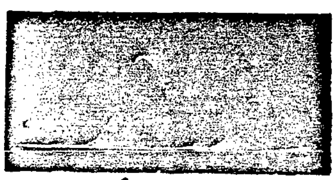
(G_C) $f = 2362.7$ Mc

(J_C) $f = 3398.5$ Mc



(H_C) $f = 2f_O = 2595.6$ Mc

(K_C) $f = 3f_O = 2893.4$ Mc



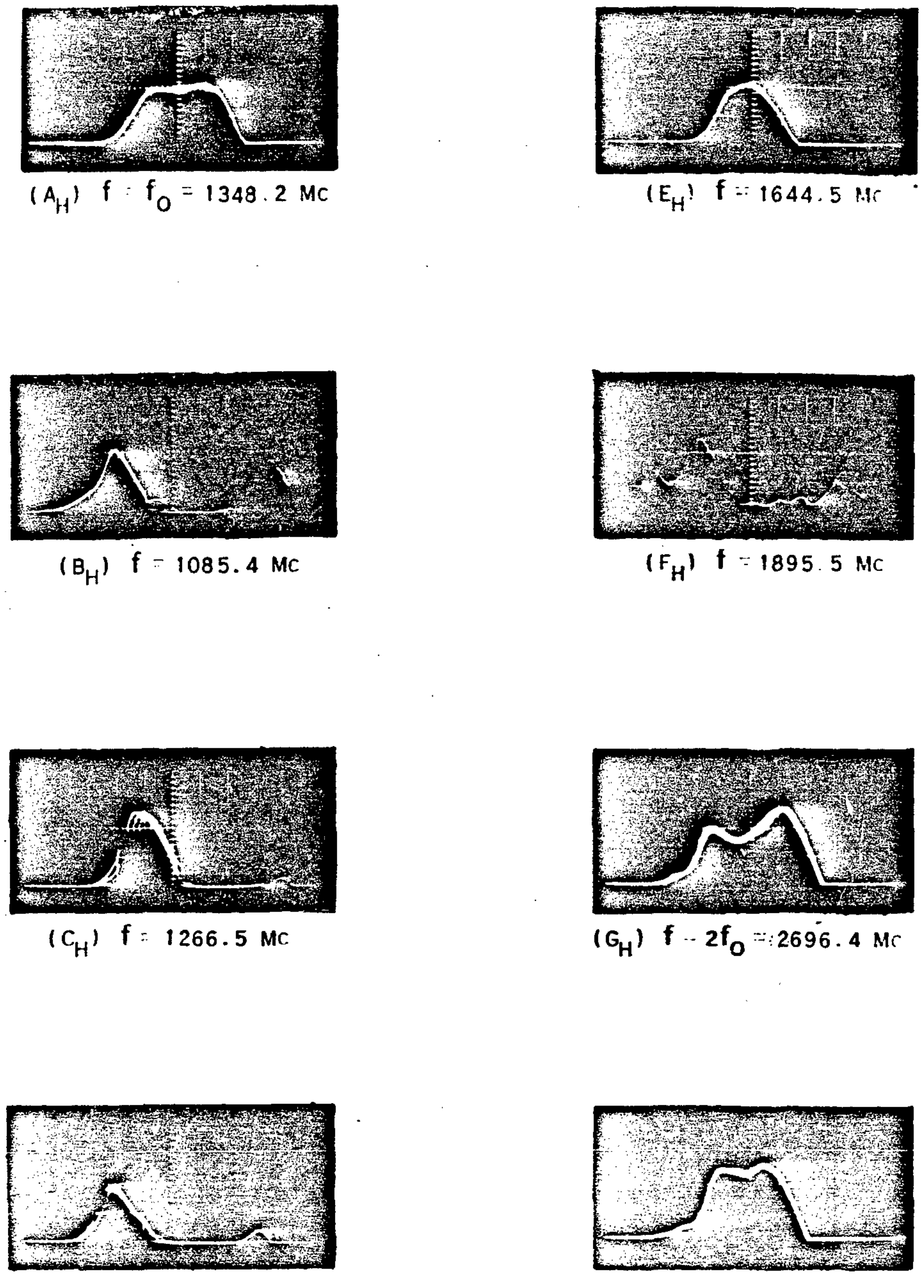
(I_C) $f = 2944.8$ Mc

(L_C) $f = 4004.4$ Mc

SWEEP TIME = 0.5 μs/CM

SWEEP LENGTH = 10.0 CM

Figure 5.2.5-5. Modulation Characteristics Photographs (f_O = 1297.8 Mc).



SWEEP TIME = 0.5 μs/CM

SWEEP LENGTH = 10.0 CM

Figure 5.2.5-6. Modulation Characteristics Photographs (f_0 = 1348.2 Mc).

TRANSMITTER MEASUREMENTS

MODULATION CHARACTERISTICS

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: *12/14/62 12/11/62

Xmtr. Serial No.: 54 Tuning Band (Mc): 1240-1350

Measuring Devices: Stoddart NM-62A, Tektronix 545A, Poloroid Scope Camera, Polarad CA-L, CA-S

Significant Control Positions: Transmitter B, Linear Polarization (Horizontal)

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Transmitter Data		Photo Identification	Scope Data			
Xmtr. Tuned Frequency (Mc)	Frequency Analyzed (Mc)		Sweep Lgth. (cm)	Sweep Time (μs/cm)	Vert. Dist. (cm)	Vert. Ampl. (v/cm)
1257.8	1257.8	A_L	10	0.5	4	2
	1085.1	B_L				
	1306.9	C_L				
	1357.1	D_L				
	1396.9	E_L				
	1417.9	F_L				
	1456.6	G_L				
	1480.8	H_L				
	1669.4	I_L				
	1790.3	J_L				
	1898.7	K_L				
*	2515.6	L_L				
*	3773.4	M_L				

Measurement Instructions

Purpose of test is to obtain information on amplitude versus time characteristics of the system radiated output. Make test at each standard test frequency for the fundamental and all spurious signals analyzed in the Spurious Emission test.

Photographs are required.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS

MODULATION CHARACTERISTICS

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: *12/19/62 12/11/62

Xmtr. Serial No.: 54 Tuning Band (Mc): 1240-1350

Measuring Devices: Stoddart NM-62A, Tektronix 545A, Poloroid Scope Camera, Polarad CA-L, CA-S

Significant Control Positions: Transmitter B, Linear Polarization (Horizontal)

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Transmitter Data		Photo Identification	Scope Data			
Xmtr. Tuned Frequency (Mc)	Frequency Analyzed (Mc)		Sweep Lgth. (cm)	Sweep Time (μs/cm)	Vert. Dist. (cm)	Vert. Ampl. (v/cm)
1297.8 *	1297.8	A_C	10	0.5	4	2
↓	1085	B_C	↓	↓	↓	↓
	1197	C_C				
	1397	D_C				
	1647	E_C				
	1898	F_C				
	2362.7	G_C				
	2595.6	H_C				
	2944.8	I_C				
	3398.5	J_C				
	3893.4	K_C				
↓	4004.4	L_C	↓	↓	↓	↓

Measurement Instructions

Purpose of test is to obtain information on amplitude versus time characteristics of the system radiated output. Make test at each standard test frequency for the fundamental and all spurious signals analyzed in the Spurious Emission test.

Photographs are required.

Use reverse side for block diagram and remarks.

TRANSMITTER MEASUREMENTS
MODULATION CHARACTERISTICS

Xmtr. & Site Identification: ARSR-1B-A 5110.11 Date: 12/15/62

Xmtr. Serial No.: 54 Tuning Band (Mc): 1240-1350

Measuring Devices: Stoddart NM-62A, Tektronix 545A, Poloroid Sccpe Camera, Polarad CA-L, CA-S

Significant Control Positions: Transmitter B, Linear Polarization (Horizontal)

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Transmitter Data		Photo Identification	Scope Data			
Xmtr. Tuned Frequency (Mc)	Frequency Analyzed (Mc)		Sweep Lgth. (cm)	Sweep Time (μs/cm)	Vert. Dist. (cm)	Vert. Ampl. (v/cm)
1348.2	1348.2	A_H	10	0.5	4	2
	1085.4	B_H				
	1266.5	C_H				
	1402.2	D_H				
	1644.5	E_H				
	1895.5	F_H				
	2696.4	G_H				
	4044.6	H_H				

Measurement Instructions

Purpose of test is to obtain information on amplitude versus time characteristics of the system radiated output. Make test at each standard test frequency for the fundamental and all spurious signals analyzed in the Spurious Emission test.

Photographs are required.

Use reverse side for block diagram and remarks.

5.2.8 Carrier Frequency Stability

The purpose of this test is to determine the transmitter frequency stability. This test is usually deleted where the transmitter frequency is derived from a crystal whose frequency stability is better than the accuracy of the measuring equipment. In the case of the ARSR transmitter, the frequency is obtained from the magnetron oscillator whose frequency stability is not as good as the accuracy of the measuring equipment. Figure 5.2.8-1 is a block diagram of the measurement setup for this test.

Frequency is measured by the Interpolation method where a special interpolation or transfer oscillator is used to zero beat against the frequency being measured. The transfer oscillator contains a highly stable 100 to 220 Mc oscillator generating harmonics for comparison. The transfer oscillator is tuned until one of its harmonics beat with the unknown frequency. The transfer oscillator frequency multiplied by the harmonic number is the frequency of the unknown. A frequency meter with an accuracy of 1 part in 10^6 is used to measure the frequency of the transfer oscillator.

Frequency measurements were made on the ARSR transmitter at 15 minute intervals for a period of four hours. The output signal was sampled at the same directional coupler output in this test as in the Power Output test.

Maximum frequency deviation measured in this test was 359 kc.

The data are recorded on one (1) data sheet.

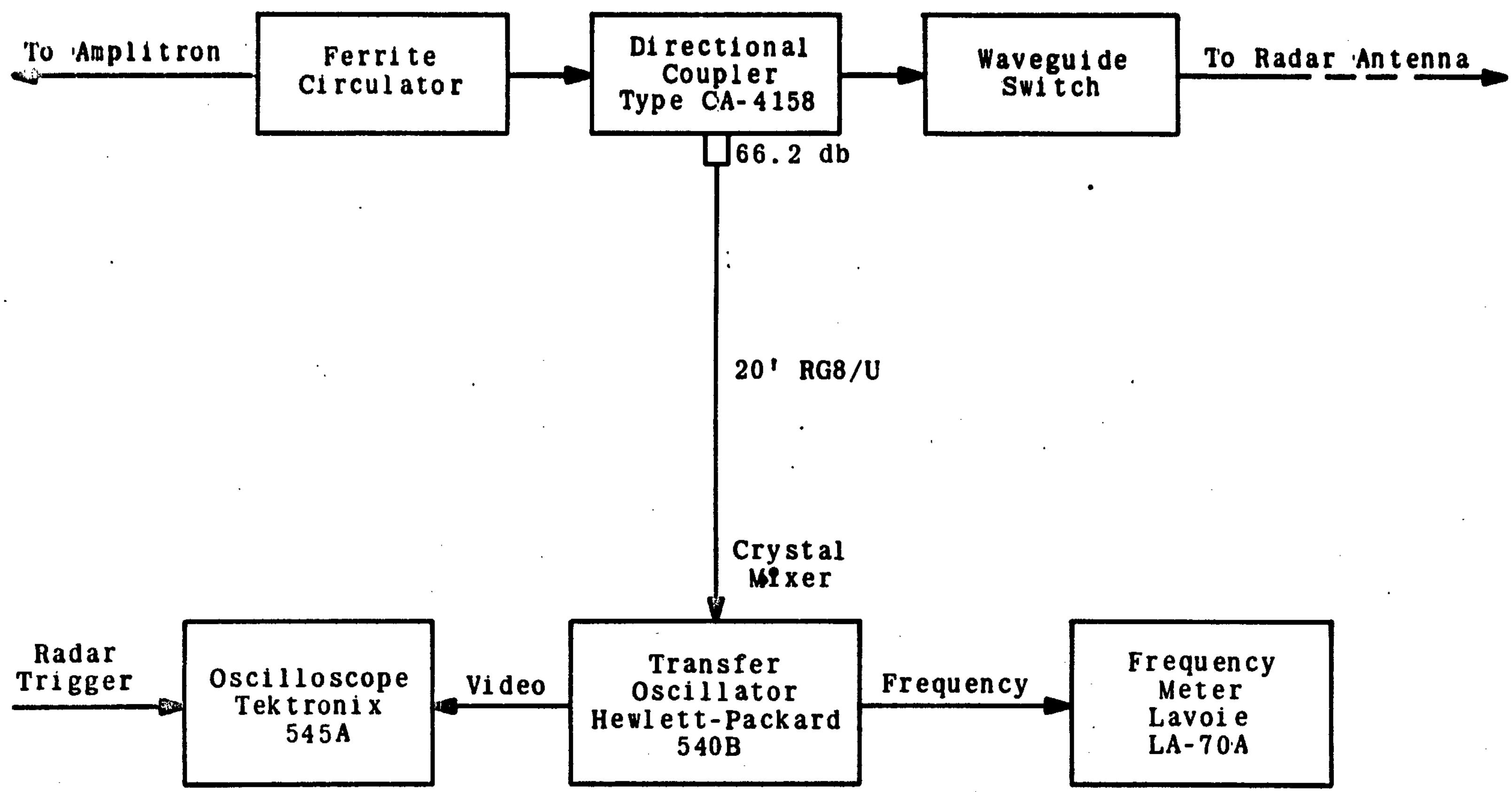


Figure 5.2.8-1. Carrier Frequency Stability Test Block Diagram.

TRANSMITTER MEASUREMENTS

CARRIER FREQUENCY STABILITY

Xmtr. & Site Identification: ARSR-1B-A Date: 12-3-62

Xmtr. Serial No.: 54 Radio Set:

Tuning Band:(Mc): 1240-1350 Xmtr. Tuned Freq. f_o (Mc):

Modulation: Pulse PW(μs): 1.8 PRF(pps): 360

Significant Control Positions: Radar Antenna Linear Polarization (Horizontal), Transmitter B

Measuring Devices: Lavoie La-70A, HP-540B, Tektronix 545A

Time of Day	Relative Time (min)	Frequency Meter Dial Reading	x	Frequency (Mc)	Frequency Deviation Δf (kc)
1830	0			1297.2138	0
1845	15			1296.8552	-358.6
1900	30			1297.1830	-30.8
1915	45			1297.2467	32.9
1930	60			1297.0680	-145.8
1945	75			1297.1386	-75.8
2000	90			1297.2195	5.7
2015	105			1297.2649	51.1
2030	120			1296.9762	-237.6
2045	135			1297.1394	-74.4
2100	150			1297.4747	260.9
2115	165			1297.0084	-205.4
2130	180			1297.1504	-63.4
2145	195			1297.1542	-59.6
2200	210			1297.2924	73.6
2215	225			1297.2654	51.6
2230	240			1297.0409	-172.9

Measurement Instructions

Tune transmitter to mean frequency of each band. Obtain frequency readout 15 minutes after transmitter is turned on and at 15-minute intervals thereafter up to 4 hours, or until a definite trend in data is established, whichever time is less. Frequency accuracy of at least one part per million is required.

Use reverse side for block diagram and remarks.

5.4 ANTENNA MEASUREMENTS

Antenna patterns were to be made only if they could be obtained with the antenna rotating at a speed of 1 rpm or less. The ARSR-1B-A antenna normally operates at 6 rpm and can be operated at speeds of 9 and 12 revolutions per minute. There are no provisions for rotating the antenna at speeds slower than 6 rpm. Since the measurement team was required to restore the antenna to normal operation within a period of 30 minutes, no elaborate modification could be used for driving the antenna. The large antenna drive motor could not be disconnected from the drive shaft of the antenna. A small variable speed motor which had been used successfully in other tasks to reduce the antenna speeds was used to drive the ARSR antenna. A flat-belt pulley was used on a collar between the motor and antenna drive shaft. No trouble was experienced in driving the antenna when the wind speed was down to a few miles an hour. However, when the wind speeds were above 5 miles per hour the speed of the antenna would vary depending upon the antenna bearing and wind direction. At high wind speeds, the motor would stall when the antenna came into the wind.

During the time of the spectrum signature measurements, the radar was never obtained during periods of very low wind velocities due to missile firing priority. Due to these circumstances, no antenna patterns were obtained.

Section 6

PULSE COUNT INVESTIGATION

This test was made as part of a continuing investigation into the possibility of using a pulse counting technique for emission spectrum measurement of a radar with scanning antenna.

Figure 6-1 is a block diagram of the setup for the Pulse Count test. In some of the earlier tests in this program, it had been found that the counter would read as much as three times the PRF when the receiver was connected directly to the counter. It was determined at the time that a pulse generator or some other threshold device was needed in order to isolate the receiver from the counter. The Tektronix scope was found to have a built-in threshold device in the input triggering system. By placing the sync selector to external and by adjusting the trigger level, it was found the voltage level could be adjusted to the point where the trace is triggered. The scope will trigger a trace for each pulse that exceeds the trigger threshold and will not trigger again until the trace has completed its horizontal sweep. The sweep must be set to a speed such that the trace is completed before the time for the next pulse. A pulse is present at the "A" gate output of the oscilloscope each time the trace is triggered. The total pulse count can be obtained by connecting this output to the input of the counter.

The receiver is tuned to the radar transmitter fundamental frequency. With the counter threshold set just above the level at which noise pulses are counted, the signal generator is connected to the receiver input and tuned to the receiver frequency. A calibration is then made to determine the minimum pulse power required for the counter to register the full count of signal generator pulses. The signal generator pulse output is set to the same PRF (360) and pulse width (2 microseconds) as the ARSR radar.

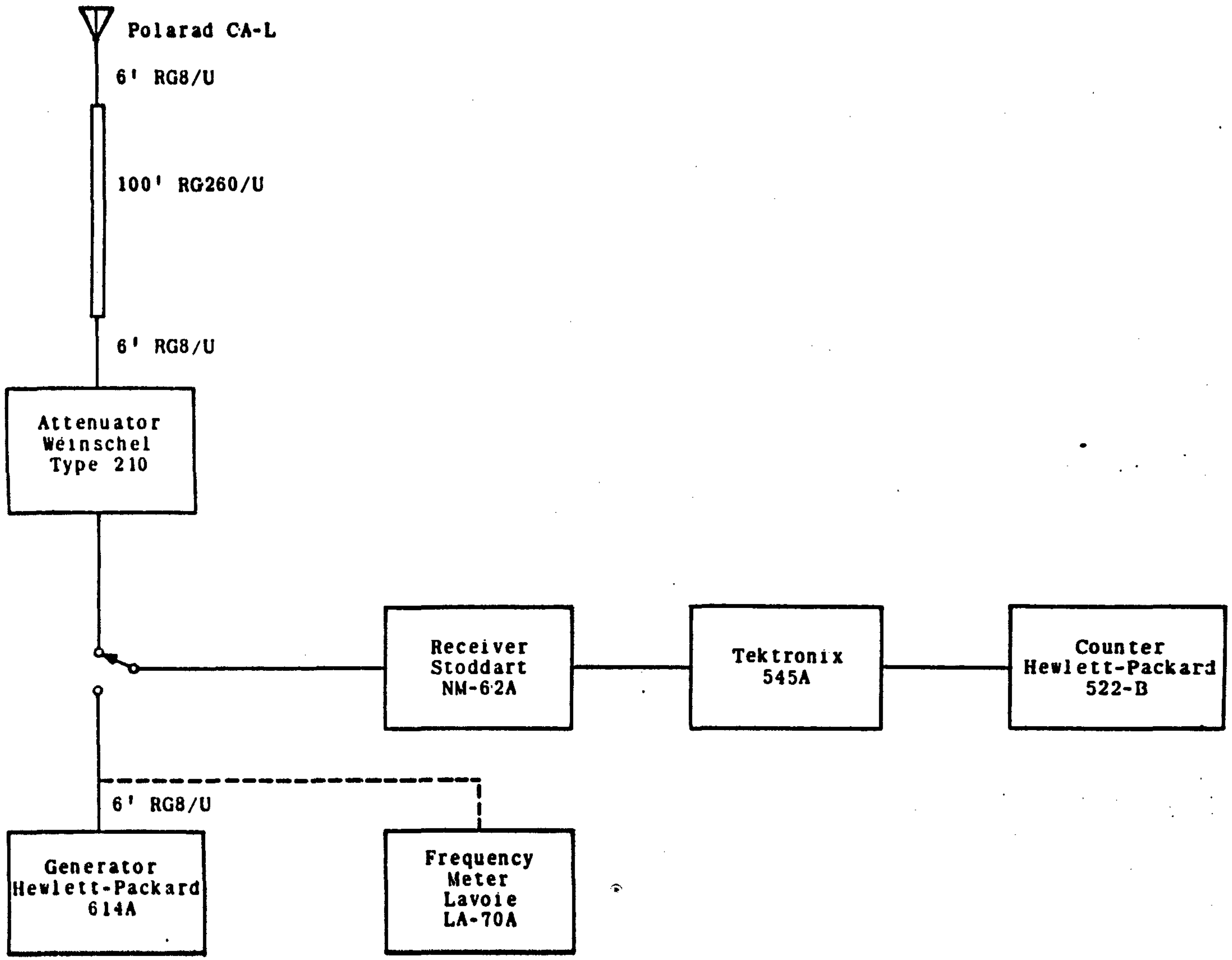


Figure 6-1. Pulse Count Test, Block Diagram.

Signal generator power and pulse count for a ten-second interval are tabulated below.

Signal Generator Output (dbm)	Pulse Count (10 seconds)
-81	68
-80	133
-79	222
-78	386
-77	668
-76	1050
-75	1521
-74	2011
-73	2571
-72	3032
-71	3372
-70	3537
-69	3611
-68	3624
-67	3628
-66	3629

The receiver is now connected to the test antenna which is directed toward the radar. With the radar restored to normal operation (6 rpm and antenna elevated 2.5°), the pulse count for a single scan is taken with the receiver at maximum sensitivity.

The counter is set to count for 10 seconds which is the time of a single scan for an antenna rotating at 6 rpm. Attenuation is then inserted between the antenna and receiver input and the 10 second pulse count taken for each attenuator setting. Attenuation is inserted until the false count level is reached. The receiver is tuned in discrete frequency steps above and below the radar tuned frequency and the above procedure is repeated. The radar transmitter was tuned to the mean standard test frequency of 1296.8 Mc for the Pulse Count test. The data obtained in this test are tabulated below.

Receiver Tuned Below f_o

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.8	0	1296.8	0	3585
			10	3576
			20	3556
			25	3531
			30	3500
			35	3450
			40	3315
			45	3062
			50	2668
			55	2075
			60	1204
			65	409
			70	108
			75	45
			80	37
			85	28
			90	27
			95	18
1296.8	-1.0	1295.8	0	3577
			10	3554
			20	3496
			30	3279
			40	2589
			45	2008
			50	1242
			55	454
			60	114
			65	42
			70	30
			75	28
			80	23
			85	16
			90	12
1296.8	-2.0	1294.8	0	3567
			10	3525
			20	3429
			30	3020
			35	2597
			40	1949
			45	1110
			50	380

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.8	-2.0	1294.8	55	106
			60	51
			65	33
			70	27
			75	23
			80	12
1296.8	-3.0	1293.8	0	3553
			10	3495
			20	3339
			30	2675
			35	2243
			40	1433
			45	607
			50	183
			55	59
			60	34
			65	26
			70	22
			75	14
1296.8	-4.0	1292.8	0	3532
			10	3413
			20	3182
			30	2442
			35	1722
			40	921
			45	265
			50	78
			55	34
			60	28
			65	27
			70	21
			75	10
1296.8	-5.0	1291.8	0	3477
			10	3319
			20	2839
			30	1655
			35	846
			40	282
			45	84
			50	39
			55	27
			60	25
			65	19
			70	

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.8	-6.0	1290.8	0	3459
			10	3252
			20	2553
			30	1056
			35	441
			40	117
			45	51
			50	29
			55	25
			60	21
			65	10
1296.8	-7.0	1289.8	0	3406
			10	3086
			20	2283
			30	872
			35	277
			40	89
			45	41
			50	27
			55	25
			60	16
1296.8	-8.0	1288.8	0	3329
			10	2945
			20	1985
			30	640
			35	204
			40	69
			45	33
			50	32
			55	23
			60	12
1296.8	-9.0	1287.8	0	3106
			10	2532
			20	1315
			30	292
			35	80
			40	45
			45	25
			50	21
			55	19
			60	10

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.8	-11.0	1285.8	0	3398
			10	3066
			20	2245
			30	427
			35	288
			40	86
			45	58
			50	29
			55	23
			60	20
			65	9
1296.8	-15.0	1281.8	0	2556
			10	1666
			20	662
			25	332
			30	165
			35	48
			40	33
			45	23
			50	16
			55	10
1296.8	-19.0	1277.8	0	2669
			10	1884
			20	871
			25	417
			30	168
			35	62
			40	31
			45	20
			50	15
			55	11
			60	6
1296.8	-27.0	1269.8	0	2875
			10	2203
			20	1225
			25	691
			30	311
			35	101
			40	34
			45	27
			50	26
			55	16
			60	16

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.8	-32.0	1265.8	0	2785
			10	2131
			20	1156
			30	254
			35	67
			40	30
			45	24
			50	21
			55	13
			60	15
1296.8	-39.0	1257.8	0	2769
			10	2039
			20	1065
			25	538
			30	231
			35	69
			40	47
			45	30
			50	28
			55	12
			60	10
1296.8	-65.1	1231.7	0	2415
			10	1385
			20	407
			25	156
			30	56
			35	35
			40	30
			45	21
			50	9
			55	13
1296.8	-114.7	1182.1	0	1502
			10	319
			15	73
			20	39
			25	32
			30	32
			35	27
			40	15
1296.8	-124.7	1172.1	0	132
			5	54
			10	38
			15	31
			20	22
			25	16

Receiver Tuned Above f_o

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.9	0	1296.9	0	3581
			10	3555
			20	3537
			30	3421
			40	3052
			45	2673
			50	2161
			55	1449
			60	522
			65	69
			70	43
			75	31
			80	24
			85	21
			90	16
1296.9	1.0	1297.9	0	3551
			10	3494
			20	3262
			30	2628
			35	2138
			40	1297
			45	279
			50	66
			55	33
			60	27
			65	22
			70	17
			75	9
1296.9	2.0	1298.9	0	3423
			10	3217
			20	2936
			30	1619
			35	1011
			40	307
			45	44
			50	31
			55	23
			60	21
			65	17
			70	7

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.9	3.0	1299.0	0	3464
			10	3160
			20	2117
			25	1651
			30	589
			35	374
			40	65
			45	33
			50	21
			55	27
			60	13
1296.9	4.0	1300.9	0	3328
			10	2982
			20	2159
			25	1323
			30	517
			35	69
			40	35
			45	27
			50	26
			55	24
			60	7
			65	0
1296.9	5.0	1301.9	0	3399
			10	3021
			20	1931
			25	1168
			30	407
			35	121
			40	40
			45	37
			50	29
			55	23
			60	10
1296.9	6.0	1302.9	0	3292
			10	2821
			20	1772
			25	934
			30	233
			35	32
			40	34
			45	25
			50	36
			55	32

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.9	7.0	1303.9	0	2855
			10	2664
			20	1190
			25	478
			30	137
			35	55
			40	26
			45	24
			50	25
			55	14
			60	14
			65	9
			70	12
1296.9	8.0	1304.9	0	3236
			10	2509
			20	977
			25	397
			30	124
			35	63
			40	42
			45	37
			50	41
			55	19
			60	11
			65	9
1296.9	9.0	1305.9	0	3238
			10	2453
			20	908
			25	359
			30	103
			35	45
			40	46
			45	34
			50	30
			55	20
			60	8
1296.9	10.0	1306.9	0	3027
			10	2132
			20	604
			25	230
			30	82
			35	34
			40	32
			43	24
			46	25
			50	25
			55	7

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.9	11.0	1307.9	0	2994
			10	2093
			20	653
			25	316
			30	101
			35	46
			40	29
			45	26
			50	33
			55	22
			60	26
			65	13
1296.9	15.0	1311.9	0	2996
			10	2106
			20	743
			25	346
			30	121
			35	48
			40	35
			45	24
			50	29
			55	17
1296.9	19.0	1315.9	0	2800
			10	1759
			20	549
			25	219
			30	79
			35	46
			40	35
			45	29
			50	21
			55	14
			60	11
			65	9
1296.9	23.0	1319.9	0	2488
			10	1425
			20	419
			25	205
			30	68
			35	38
			40	29
			45	26
			50	22
			55	11
			60	11

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.9	27.0	1323.9	0	2099
			10	1238
			20	360
			25	139
			30	59
			35	35
			40	27
			45	14
			50	20
			55	13
1296.9	31.0	1327.9	0	1931
			10	901
			15	536
			20	253
			25	103
			30	45
			35	31
			40	31
			45	22
			50	16
			55	12
1296.9	35.0	1331.9	0	1864
			10	783
			15	394
			20	175
			25	71
			30	39
			35	36
			40	20
			45	15
			50	14
1296.9	39.0	1335.9	0	1816
			10	709
			15	333
			20	148
			25	83
			30	40
			35	26
			40	25
			45	22
			50	24
			55	23
			60	13

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.9	43.0	1339.9	0	1840
			10	679
			15	358
			20	148
			25	78
			30	40
			35	33
			40	28
			45	27
			50	11
1296.9	83.9	1380.8	0	2370
			10	1467
			15	960
			20	582
			25	263
			30	92
			35	46
			40	39
			45	21
			50	17
			55	15
1296.9	137.2	1434.1	0	1949
			10	651
			15	243
			20	92
			25	45
			30	36
			35	32
			40	30
			45	27
			50	14
1296.9	182.2	1479.1	0	827
			10	164
			15	68
			20	56
			25	50
			30	40
			35	33
			40	25
			45	17

f_o (Mc)	Deviation (Mc)	Receiver Frequency (Mc)	Receiver Attenuation (db)	Pulse Count
1296.9	214.6	1511.5	0	110
			5	55
			10	36
			15	37
			20	30
			25	17
			30	15
1296.6	335.9	1632.8	0	290
			5	66
			10	39
			15	31
			20	30
			25	18
			30	14
			35	17
1296.9	486.2	1783.1	0	45
			5	35
			10	22
			15	17

Data obtained with the receiver tuned below f_o is plotted in Figure 6-2. In this figure, the pulse count with the maximum attenuation before the receiver is plotted as the 0 db level. All other points are plotted relative to this maximum attenuation. From plots of these data, the relative power level to that at the fundamental, at each measured frequency, can be scaled at a constant pulse rate. Data obtained with the receiver tuned above f_o are shown plotted in Figure 6-3. A receiver bandwidth of 0.5 Mc was selected for this test. Relative power level scaled at a pulse rate of 100 pulses per scan is plotted in Figure 6-4. A comparison of Figure 6-4 with the automatic spurious emission scans in Figures 5.2.3-19,20, and 21 shows a great amount of similarity between the curves.

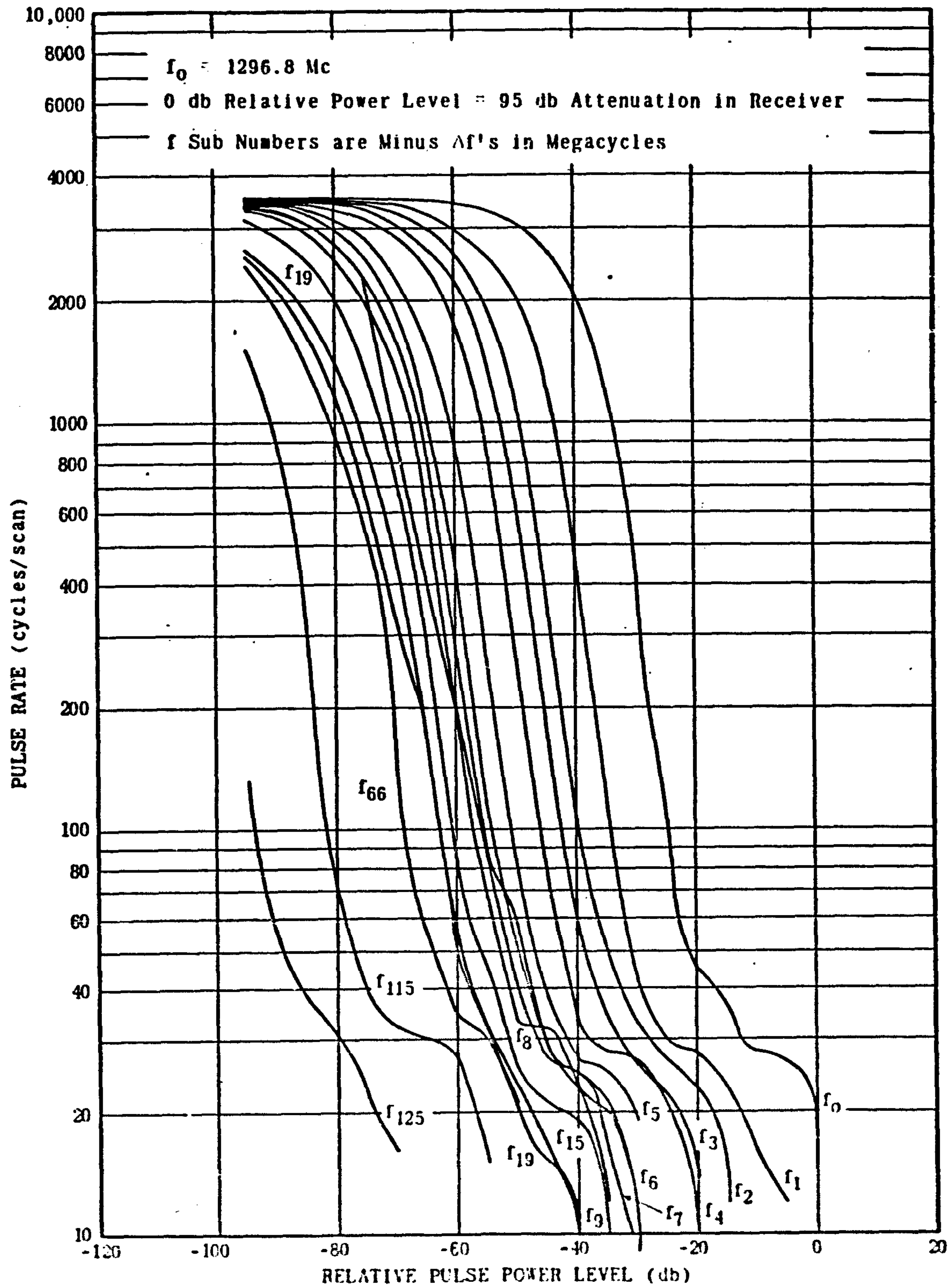


Figure 6-2. Pulse Rate as a Function of Receiver Sensitivity, ($-\Delta f$).

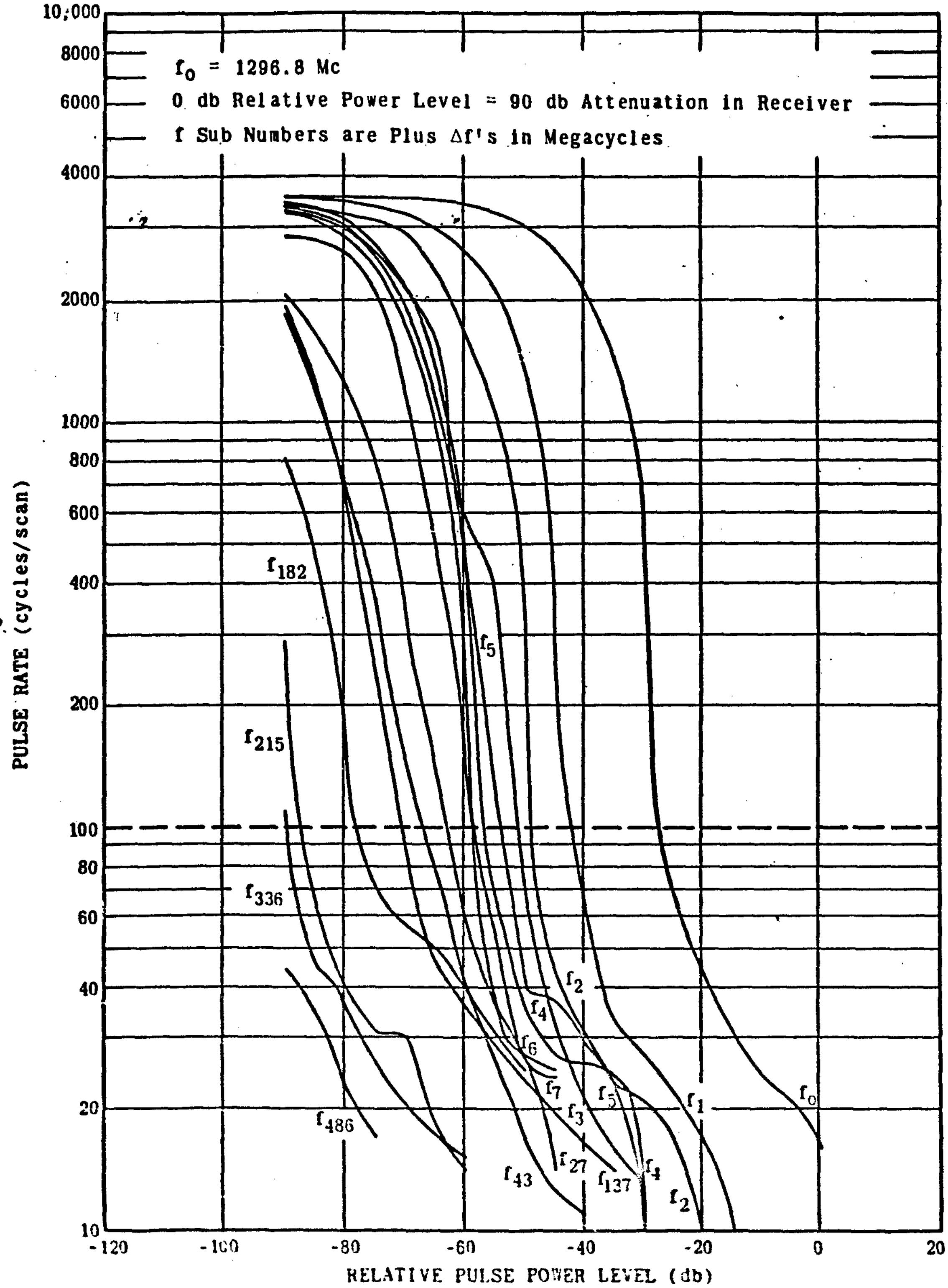


Figure 6-3. Pulse Rate as a Function of Receiver Sensitivity, (+Δf).

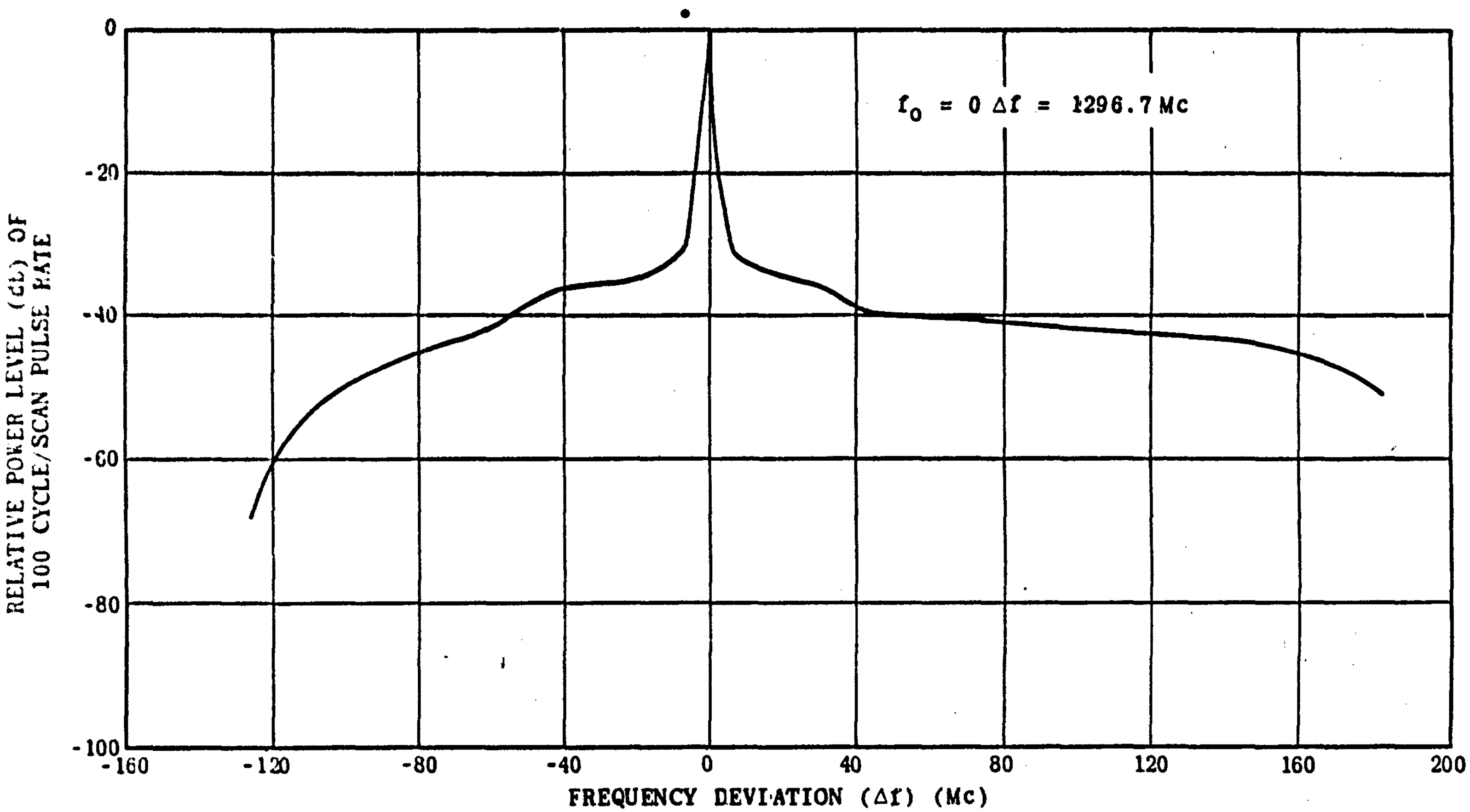


Figure 6-4. Relative Pulse Power for Constant Pulse Rate.